

GATE Life Sciences 2010

Gate Life Sciences question paper contains six sections out of which sections: GA (General Aptitude) and H (Chemistry) are compulsory sections. Out of the remaining, sections, *i.e.*, section I (Biochemistry), J (Botany), K (Microbiology), L (Zoology), the candidate has to choose two more sections.

This document contains the complete set of questions from Biochemistry section along with correct answers reinforced with explanations.

The remaining sections have been partly answered along with explanations.

Biochemistry

Q.1 –Q.10 carry one mark each

1. Nucleolus is involved in the synthesis of

- A. rRNA
- B. tRNA
- C. DNA
- D. mRNA

Ans A

Exp: The nucleolus is involved in the synthesis of ribosomal RNA which act as building blocks of ribosomes.

2. In tryptophan operon, tryptophan acts as a

- A. Repressor
- B. Activator
- C. Co-repressor
- D. Co-activator

Ans C

Exp: Tryptophan molecule acts as a co-repressor which when bound to the repressor enhances its ability to bind to the operator region. And hence the level of tryptophan in the cell regulates the transcription of trp operon.

3. Positive selection of T cells ensures

- A. MHC restriction
- B. TCR engagements
- C. Self tolerance
- D. Activation by co – stimulatory signal

Ans A

Exp: The T cell receptors recognize antigen only in the context of MHC's. Hence T cells are tuned to recognize host MHC first. Positive selection ensures the T cell only reacts to self MHC (MHC restriction) and takes place in the cortical region of the thymus. T cells that do not recognize self MHC die via Apoptosis.

4. A DNA binding motif is

- A. Helix-loop-helix
- B. Helix-turn-helix
- C. Helical wheel
- D. Loop-helix-loop

Ans Both A and B

Exp: Within the DNA binding domain there is at least one motif which recognizes the DNA and they determine which of the gene has to be transcribed. Four major motifs present in the DNA binding proteins are Helix-loop-helix, Helix-turn-helix, Leucine zipper motif and Zinc finger motif.

5. Amino acids responsible for N-linked and O-linked glycosylation of proteins are

- A. Asparagine and aspartic acid
- B. Glutamic acid and serine
- C. Glutamine and serine
- D. Asparagine and Threonine

Ans D

Exp: All N-linked glycosylation involves the addition of N-Acetylglucosamine to the amino acid asparagine. The N-linked amino acid consensus sequence is Asn-any AA-Ser or Thr. The middle amino acid can not be proline (Pro). Most O-linked glycosylation involves the addition of N-Acetylgalactosamine to the amino acids serine or threonine.

6. One of the following is not a neurotransmitter

- A. Dopamine
- B. Glutamic acid
- C. Histidine
- D. Glycine

Ans C

Exp: Amino acids like glutamic acid, aspartic acid, glycine, D-serine and biogenic amines like Dopamine, epinephrine, norepinephrine act as neurotransmitters.

7. Approximate molecular weight (kDa) of the product after translation of a 390 bases mRNA will be

- A. 48
- B. 26
- C. 39
- D. 14

Ans D

Exp: There are 390 bases in mRNA and they lead to the synthesis of $390/3 = 130$ amino acids after translation. Average weight of an amino acid is 110 Daltons. Hence the weight of translated product is $130 \times 110 = 14300$ Daltons or ~14KDa.

8. Lineweaver-Burk plot is a plot of

- A. $\frac{1}{v_0}$ vs $\frac{1}{[S]}$
- B. v_0 vs $[S]$
- C. v_0 vs $\frac{1}{[S]}$
- D. $\frac{1}{v_0}$ vs $[S]$

Ans: A

Exp: It is a double reciprocal plot which explains enzyme kinetics and was Hans Lineweaver and Dean Burk in 1934. This plot is useful for analysis of Michaelis–Menten equation. Here V_0 stands for initial velocity and $[S]$ stands for substrate concentration.

9. A mixture of proteins (W, X, Y, Z) elute from Sephadex G-200 column in the order W, X, Y, Z. The protein with maximum electrophoretic mobility on SDS-PAGE will be

- A. W
- B. X
- C. Y
- D. Z

Ans D

Exp: Gel filtration in Sephadex results in larger molecules eluting from the column first. In this case W is the largest molecule and Z is the smallest molecule. The SDS-denatured polypeptides are finally separated on the basis of their relative molecular mass in Polyacrylamide gels. The protein Z shows maximum electrophoretic mobility as it has a lower molecular mass.

10. Specific precursor for all prostaglandins is

- A. Oleic acid

- B. Arachidonic acid
- C. Palmitic acid
- D. α -Linolenic acid

Ans B

Exp - Prostaglandins are derived from 20-carbon polyunsaturated fatty acid that is Arachidonic acid. Stores of arachidonic acid are present in membrane lipids and released through the action of various lipases.

Q.11-Q.20 carry two marks each

11. Chymotrypsin and lysozymes are involved respectively in

- P. Removal of successive carboxyl terminal residues
- Q. Hydrolytic cleavage of peptide bond
- R. Cleavage of glycosidic C-O bond
- S. Oxygen transport in blood

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

Ans B

Exp. Chymotrypsin is responsible for cleaving peptide bonds following a bulky hydrophobic amino acid residue. Preferred residues include phenylalanine, tryptophan, and tyrosine. Lysozyme, also known as muramidase attacks the peptidoglycans found in the cell walls of bacteria, especially Gram-positive bacteria. It hydrolyses the glycosidic bond that connects N-acetylmuramic acid with the fourth carbon atom of N-acetylglucosamine.

12. Match the items in Group I with those in Group 2

Group 1

- P. Isotype switching
- Q. Clonal allergy
- R. Class II MHC
- S. Self tolerance

Group 2

1. V_H domain
2. Non-responsive to self antigens
3. Non –responsive to T_H cells
4. β_2 -microglobulin

- (A) P-1, Q-4, R-3, S-2
- (B) P-2, Q-4, R-1, S-3
- (C) P-1, Q-3, R-4, S-2
- (D) P-2, Q-1, R-3, S-4

Ans (C)

13. Multiple RNA polymerase transcribes a DNA template, unwinding about 1.5 turns of DNA template per transcription bubble. From the structural information of classical B-DNA, how many transcription bubbles for a 180 base pair DNA molecule?

- A. 12
- B. 27
- C. 6
- D. 270

Ans A

Exp – Number of base pairs present per turn are 10. Hence in a stretch of 180 base pairs we get $180/10 = 18$ turns.

1.5 turns makes one transcription bubble hence when there are 18 turns we have $18/1.5 = 12$ transcription bubbles.

14. Match the items in Group I with the most appropriate separation techniques in group2

<u>Group I</u>	<u>Group 2</u>
<ul style="list-style-type: none"> P. Mixture of glycine and albumin Q. Mixture of 20 and 60 kDa proteins R. Histones from nuclear extract S. Lectins 	<ol style="list-style-type: none"> 1. Gas chromatography 2. Dialysis 3. Affinity chromatography 4. Size exclusion chromatography 5. Thin layer chromatography 6. Cation exchange chromatography

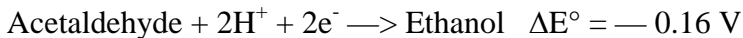
- (A) P-1, Q4, R-3, S-5
- (B) P-5, Q-3, R-6, S-1

(C) P-2, Q-4, R-6, S-3

(D) P-6, Q-5, R-2, S-4

Ans D

15. In the two half reactions



(F = 23,063 cal/V)

The ΔG° for coupled reaction will be

(A) +7,400 cal

(B) -7,400 cal

(C) -22,200 cal

(D) +22,200 cal

Ans D

Exp: $\Delta G^\circ = -nFE^\circ$ ΔE° For this coupled reaction is $-0.16\text{V} + (-0.32\text{V}) = -0.48 \text{ V}$ $\Delta G^\circ = -2 \times 23,063 \times (-0.48) = 22140.48$. After rounding +22,200 cal

16. Match the parameters in group 1 with the correct options in group 2

<u>Group 1</u>	<u>Group 2</u>
P. K_M	1. Catalytic efficiency of the enzyme
Q. k_{cat}/K_M	2. Affinity of enzyme to the inhibitor
R. pK_2	3. Affinity of enzyme to the substrate
S. K_i	4. Maximum buffering capacity

(A) P-3, Q-1, R-2, S-4

(B) P-3, Q-1, R-4, S-2

(C) P-1, Q-2, R-4, S-3

(D) P-1, Q-4, R-2, S-3

Ans B

17. The rise per residue of α -helix is about 1.5\AA . A protein spans 4nm bilayer 7 times through its transmembrane α -helical domain. Approximately, how many amino acid residues constitute the transmembrane domain of the protein?

A. 105

B. 450

- C. 30
D. 190

Ans D

Exp: The bilayer is 4nm thick that is 40 \AA thick. As $10 \text{ \AA} = 1\text{nm}$. The protein travels through it 7 times that is it covers a distance of $40 \times 7 = 280 \text{ \AA}$. The rise per AA residue is 1.5 \AA . Hence the number of amino acids present in this domain is $280/1.5$.

18. Match the proteins in Group 1 with their correct functions in Group2

<u>Group1</u>	<u>Group2</u>
P. Shaker protein	1. Inner membrane receptor
Q. Bacteriorhodopsin	2. Active transport
R. Porin	3. Voltage gated K^+ channel
S. ABC transporter	4. Light driven H^+ pump
	5. Membrane fusion
	6. β - barrel simple diffusion channel

- (A) P-4, Q-2, R-3, S-5
(B) P-5, Q-3, R-4, S-6
(C) P-6, Q-1, R-5, S-4
(D) P-3, Q-4, R-6, S-2

Ans D

19. The metabolic disorders, Alkaptonuria and Phenylketonuria are caused by defects in the enzymes

- P. Glucose -6- phosphatase
Q. Phenylalanine hydroxylase
R. Homogentisate 1,2-dioxygenase
S. Tyrosinase

- A) Q,R
B) P,R
C) P,Q
D) Q,S

Ans A

Exp: **Alkaptonuria** arises due to defect in the enzyme homogentisate 1,2-dioxygenase. There is a failure in the degradation of tyrosine which results into accumulation of homogentisic acid in the blood and is excreted in urine in large amounts.

Phenylketonuria is characterized by a mutation in the gene for the hepatic enzyme phenylalanine hydroxylase (PAH), rendering it nonfunctional. This enzyme metabolizes phenylalanine (Phe) to the amino acid tyrosine. Reduced activity of this enzyme leads to accumulation of phenylalanine which later gets converted to phenylpyruvate and excreted out in urine.

20. Match the metabolic pathways in Group1 with the corresponding enzymes in Group2

Group 1	Group2
P. β – oxidation	1. Ribulose biphosphate carboxylase
Q. Glycolysis	2. Phosphofructokinase 1
R. Gluconeogenesis	3. Phosphoenol pyruvate carboxykinase
S. Calvin cycle	4. Thiolase
	5. Phosphofructokinase 2

- (A) P-4, Q-2, R-3, S-5
 (B) P-3, Q-2, R-4, S-1
 (C) P-3, Q-1, R-5, S-2
 (D) P-4, Q-2, R-3, S-1

Ans D

Botany

Q.1 –Q.7 carry one mark each

1. When changes in the phenotype or gene expression occur without changes in the underlying DNA sequence, the phenomenon is called

- A. Mutation
 B. Eugenics
 C. Epigenetics
 D. Epistasis

Ans C

Exp: Changes in gene expression may be brought about by DNA methylation or histone deacetylation. In both the cases gene expression is suppressed without altering the sequence of the silenced genes.

2. A population growing exponentially can be described by the differential equation $dN/dt = rN$, where dN/dt represents the rate at which the whole population grows, N is

the size of the population, r is the intrinsic rate of increase, and t is time. According to this equation the per capita rate of growth is

- A. Highest at large N
- B. Constant
- C. Lowest at large N
- D. Highest at small N

Ans A

Exp: The relationship between dN/dt and N is linear (a straight line.) Remembering the formula for a straight line, $Y=mX+b$, note that if we let our Y variable be dN/dt and our X variable be N , that a plot of dN/dt versus N will be a straight line with slope r .

3. Which one of the following is not a plant hormone?

- A. Abscisic acid
- B. Brassinosteroid
- C. Ethylene
- D. Cytokine

Ans D

Cytokinins are plant hormones that are derivatives of the purine adenine. Cytokinins play an important role in mitosis, chloroplast development, differentiation of the shoot meristem etc. They are not to be confused with cytokines which are small cell-signaling protein molecules.

4. *Arabidopsis* and rice have diploid chromosome numbers of 10 and 24, respectively. Assuming no crossing over taking place, genetic variation among F_2 individuals in a genetic cross is likely to be

- A. Same in both species but not zero
- B. More in *Arabidopsis*
- C. More in rice
- D. Zero in both the species

Ans C

Exp: The number of possible combinations of maternal and paternal homologues due to random assortment is 2^n , where n = the haploid number of chromosomes. Haploid number in rice is 12 and in *Arabidopsis* 5. Genetic variation among F_2 individuals due to random assortment is $2^{12} > 2^5$

5. The possible genotypes of endosperms borne on a heterozygous (Rr) plant will be

- (A) RRR, RRr, Rrr, rrr
- (B) RRr, Rrr
- (C) RR, Rr, rr
- (D) Rr

Ans C

6. The amount of chemical energy available to consumers in an ecosystem is best represented by

- (A) Gross primary production
- (B) Net primary production
- (C) Respiration
- (D) Photosynthesis

Ans B

7. Gross primary production (GPP) is the rate at which producers capture and store a given amount of chemical energy as biomass in a given length of time. Some fraction of this fixed energy is used by primary producers for cellular respiration and maintenance of existing tissues. The remaining fixed energy is net primary production (NPP) and is available to the consumers.

$$\text{NPP} = \text{GPP} - \text{respiration [by plants]}$$

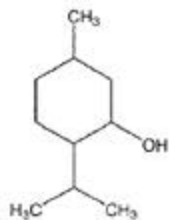
Q.11 -- Q.14 carry two marks each.

11. Identify the CORRECT statements from the following

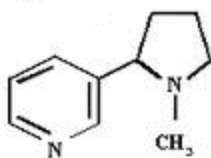
- P. Lenticels are the small pores present on the surface of the stem or branches of woody plants
- Q. Glyoxysomes contain chlorophyll molecules in their thylakoid membranes
- R. The enzyme ribulose 1,5 bisphosphate carboxylase is otherwise known as carboxydehydratase
- S. 18 ATP and 12 NADPH molecules are utilized for fixing 6 molecules of CO in the dark reaction of photosynthesis

- (A) P, Q
- (B) P, R
- (C) Q, R
- (D) P, S

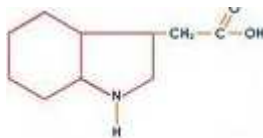
12. From the structures given below, identify the compounds



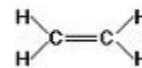
P



Q



R



S

1. Ethylene
2. Indole Butyric acid
3. Nicotine
4. Indole acetic acid
5. Gibberellic acid
6. Menthol

- (A) P-6, Q-3, R-4, S-1
 (B) P-5, Q-2, R-3, S-1
 (C) P-4, Q-3, R-2, S-6
 (D) P-1, Q-2, R-5, S-6

Ans A

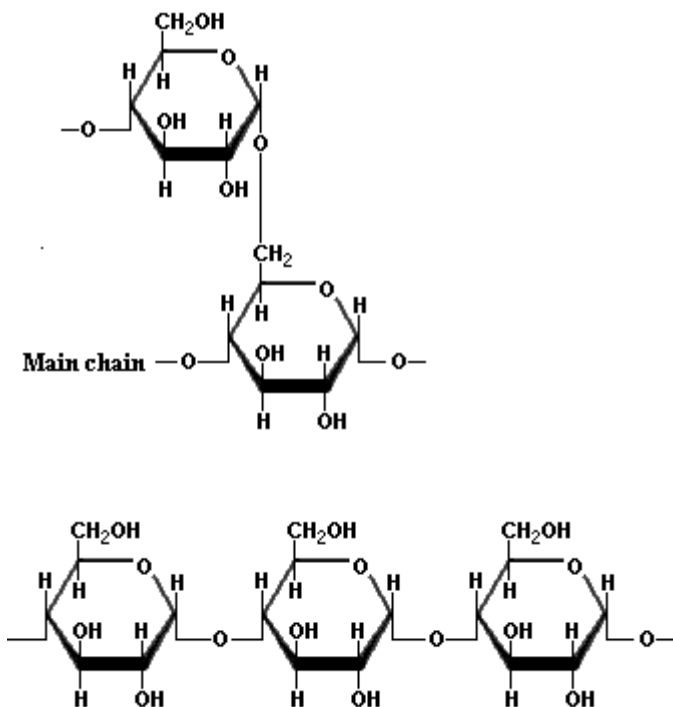
13. Regarding the relationships between two organisms in an ecosystem match the following

Group 1 (Relationship)	Group 2 (Definition)
P. Commensalism Q. Mutualism R. Parasitism S. Amensalism	<ol style="list-style-type: none"> 1. Both organisms are benefited 2. One impeding the success of the other 3. One organism benefits but the other is unaffected 4. One benefited, other is harmed

- (A) P-1, Q-2, R-3, S-4
 (B) P-2, Q-3, R-4, S-1
 (C) P-3, Q-1, R-4, S-2
 (D) P-1, Q-4, R-3, S-2

Ans (C)

14. Name the structures given below in the order of their appearance and identify corresponding glycosidic linkages



- (A) Amylose, Cellulose; (α 1 \rightarrow 4),(β 1 \rightarrow 6)
 (B) Cellulose, Dextran; (β 2 \rightarrow 4),(α 3 \rightarrow 6)
 (C) Starch, Cellulose; (α 1 \rightarrow 6),(α 1 \rightarrow 4)
 (D) Amylopectin, amylose; (α 1 \rightarrow 6),(α 1 \rightarrow 4)

Ans D

Exp: Starch is made up of amylose and amylopectin. **Amylose** consists typically of 200 to 20,000 glucose units joined by α 1 \rightarrow 4 glycosidic linkages. **Amylopectin** is highly branched and made up of short side chains of about 30 glucose units attached with 1α \rightarrow 6 linkages.

Microbiology

Q.1 –Q.6 carry one mark each

1. An electron microscope has higher resolution as compared to the light microscope. This is because

- (A) the wavelength of an electron is greater than the wavelength of light
 (B) the wavelength of an electron is shorter than the wavelength of light
 (C) the electrons can penetrate the sample better
 (D) they use different stains

Ans B

Exp: An electron microscope has a greater resolving power than a light microscope, because electrons have wavelengths about 100,000 times shorter than visible light (photons). EM has resolution better than 50 pm and magnifications of about 10,000,000x, whereas ordinary light microscopes have limited resolution, about 200 nm and magnifications below 2000x.

2. Bacterial cell lysis by lysozyme is due to the

- A. Hydrolysis of $\alpha 1 \rightarrow 4$ glycosidic bonds between the N-acetylglucosamine and N-acetylmuramic acid
- B. inhibition of cell wall synthesis
- C. hydrolysis of pentapeptide bridges
- D. hydrolysis of $\beta 1 \rightarrow 4$ glycosidic bonds between the N-acetylglucosamine and N-acetylmuramic acid

Ans D

Exp: Lysozymes are glycoside hydrolases which damage bacterial cell walls by catalyzing hydrolysis of 1,4-beta-linkages between N-acetylmuramic acid and N-acetyl-D-glucosamine residues in a peptidoglycan and between N-acetyl-D-glucosamine residues in chitodextrins.

3. The recombination frequencies between three genes x,y and z are as follows: x-y: 2.6%, y-z: 1.4%, and x-z: 1.2%. Then the gene order is

- (A) x-z-y
- (B) x-y-z
- (C) y-x-z
- (D) z-x-y

Ans A

Exp: Larger is the % of recombination frequency between the genes, greater is the distance between the genes on the chromosome.

4. A mutant phenotype due to a nonsense mutation can be rescued by a mutation in tRNA gene. This rescue is an example of

- (A) induced mutation
- (B) suppressor mutation
- (C) Spontaneous mutation
- (D) deletion mutation

Ans B

A nonsense mutation converts a codon for an amino acid to a stop codon, thus terminating the polypeptide chain prematurely. Suppressor mutations occurring elsewhere

in the genome (tRNA gene) can cause the gene containing the premature stop codon to still make complete proteins.

5. Ames test is performed to detect

- A. Mutagen
- B. pH
- C. nutrient stress
- D. salinity

Ans A

Exp: The Ames test is a biological assay to assess the mutagenic potential of chemical compounds.

6. Pasteurization of milk is carried out by

- A. Boiling for 5 min
- B. Heating at 72°C for 30 min
- C. Heating at 63°C for 15 min
- D. Heating at 63°C for 30 min

Ans C

Q.11 -- Q.13 carry two marks each.

11. Match the scientist from Group I with the corresponding contribution listed in Group II.

Group I	Group II
P. Robert Koch Q. Walter Hesse R. Louis Pasteur S. Ferdinand Cohn	1. Discovery of endospores 2. Disproved spontaneous generation 3. Discovery of causative agent of tuberculosis 4. Use of agar as solid media 5. Invention of microscope

- (A) P-5, Q-3, R-4, S-2
- (B) P-3, Q-4, R-2, S-5
- (C) P-3, Q-4, R-1, S-5
- (D) P-3, Q-4, R-2, S-1

Ans D

12. Which one of the following events occurs in prokaryotes but NOT in eukaryotes?

- A. Protein phosphorylation
- B. RNA polymerase and promoter interaction
- C. Control of transcription by attenuation
- D. Formation of Okazaki fragments

Ans C

Match the pathogen in Group 1 with the corresponding disease in Group 2

Group 1	Group 2
P. Bacteria	1. Measles
Q. Virus	2. Candidiasis
R. Fungi	3. Malaria
S. Protozoa	4. Bovine spongiform encephalitis
	5. Tuberculosis

- (A) P-1, Q-2, R-4, S-5
- (B) P-1, Q-4, R-2, S-3
- (C) P-5, Q-1, R-4, S-2
- (D) P-5, Q-1, R-2, S-3

Ans C

13. Match the microorganisms in Group I with the application in Group II

Group I	Group II
P. <i>Aspergillus oryzae</i>	1. Metal ore leaching
Q. <i>Brevibacterium flavum</i>	2. Glucoamylase producer
R. <i>Thiobacillus ferrooxidans</i>	3. Bread making
S. <i>Saccharomyces cerevisiae</i>	4. Glutamic acid producer
T. <i>Rhizobium meliloti</i>	5. Penicillin producer
	6. Symbiotic nitrogen fixer

- (A) P-1, Q-6, R-4, S-5, T-2
- (B) P-2, Q-4, R-1, S-3, T-6
- (C) P-4, Q-1, R-6, S-3, T-5
- (D) P-6, Q-2, R-3, S-5, T-1

Ans B

Zoology

Q.1 –Q.6 carry one mark each

1. Which one of the following is the smallest biological unit capable of evolving over time?

- (A) A cell
- (B) An individual organism
- (C) A population
- (D) A species

Ans C

Exp: Population represents a group of individuals of the same species, living in the same place, at the same time. It is a smallest biological unit that can evolve

2. In case of parasites that require multiple hosts to complete their life cycle, what does definitive host mean?

- (A) It is the host that harbors the sexual stages of the parasite.
- (B) It is the host in which the parasite reproduces asexually.
- (C) It is the host in which the parasite feeds.
- (D) It is the host in which the parasite remains in a dormant stage

Ans A

3. Enzymes catalyze biochemical reactions by

- (A) sequestering the product (s)
- (B) decreasing the ΔG of the reaction
- (C) increasing the ΔG of the reaction
- (D) stabilizing the transition state of the reaction.

Ans D

Exp: Enzymes catalyze the reactions by lowering the Energy of activation (E_a) and stabilizing the transition state of a reaction.

4. Which one of the following results from Mendel's Monohybrid cross is the strongest evidence against the blending theory?

- (A) 3:1 ratio of phenotypes in the F1 generation.
- (B) All progeny of the F1 generation exhibited the dominant phenotype
- (C) The recessive phenotype showed up in the F2 progeny
- (D) The observation of incomplete dominance

Ans A

Exp: According to blending theory inherited traits were determined, randomly, from a range bounded by the homologous traits found in the parents. However Mendel proved

that during cross pollination certain traits show up in offspring without any blending of parent characteristics.

5. As compared to peptide hormones, steroid hormones take more time to activate a cellular response because

- (A) Steroid hormones show non-specific binding with diverse sets of receptors.
- (B) Steroid hormone acts through a receptor which is a transcription factor
- (C) Cells that respond to steroid hormones are dormant in nature.
- (D) Peptide hormones are not transported through plasma while steroid hormones are.

Ans B

Exp: Steroid hormones act more slowly than peptide hormones because of the time required to produce new proteins as opposed to activating proteins that are already present.

6. In allopatric mode of speciation, a new species forms due to

- (A) Geographic isolation
- (B) Genetic drift
- (C) Formation of a few fertile individuals that can not mate with other members of the same species living in the same geographical area
- (D) The formation of allopolyploid condition

Ans A

Exp: Allopatric speciation occurs when biological populations of the same species become isolated due to geographical changes or isolation.

Q.11 .. Q.17 carry two marks each.

11. An alien species has been discovered with very similar genetic makeup as that of the existing species on planet earth with certain differences. The genetic material of this new species is referred to as DNA*. The building blocks of the genetic material is known as Nucleotide*. The proteins of the new species (protein*) is made up of Amino Acids*.

It has also been discovered that the new species has 5 distinct Nucleotide* as opposed to the four for species on planet earth. The new species has 40 different Amino Acids* as opposed to the 20 for species on planet earth. What should be the codon length for this new species (the same for species of planet earth is 3)? It may be assumed that the average codon degeneracy of the new species is very similar to that of species of planet earth.

- (A) 2
- (B) 3
- (C) 4

(D) 5

Ans 3

Exp : If there were two bases per codon, then only $5^2 = 25$ amino acids could be coded. Because at least 41 codes are required (40 amino acids plus stop), and the next largest number of bases is three, then 5^3 gives 125 possible codons. It is assumed that average codon degeneracy of the new species is very similar to that of species of planet earth.

12. In the field of community ecology, the term "competitive exclusion" refers to two species that cannot co-exist

- (A) in a community if the niches are identical.
- (B) in two different communities if the niches are identical.
- (C) if the ecosystem is imbalanced.
- (D) in the event of a volcanic eruption.

Ans A

Exp: According to competitive exclusion principle, if two species, with the same niche, coexist in the same ecosystem, then one will be excluded from the community due to intense competition.

13. During immune response, helper T-cell memory against the antigen appears earlier than the B memory cells. Which one of the following is the primary reason for this phenomenon?

- (A) Affinity of antibody molecules produced by B cells is weaker than those of T cells
- (B) B memory cells proliferate at a rate slower than that of T cells
- (C) B-cell activation requires helper T Cells
- (D) Thymic selection more rapidly enhances the T cell population than B cell population

14. Oceans have enormous impact on the biosphere. Identify which one of the following factors is NOT influenced by the marine biome.

- (A) CO₂ level in the atmosphere
- (B) Climatic change in the terrestrial biome.
- (C) pH of the fresh water bodies
- (D) Oxygen level in the biosphere.

Ans C

15. Certain lung fishes that live in small stagnant fresh water pools produce urea as a nitrogenous waste. What is the advantage of this adaptation?

- (A) Urea form precipitates and does not accumulate in the surrounding water.
- (B) Lung fish do not find enough water for production of ammonia and hence the nitrogenous waste is excreted as urea.
- (C) The excreted urea makes the pool uninhabitable to the predators of the lung fish.
- (D) Urea requires much less energy for its synthesis than ammonia.

Ans B

Exp: Ammonia is extremely toxic, and a large volume of water is required to maintain the excreted ammonia level lower than the body level. Urea is less toxic than ammonia, and requires less water for elimination. Lungfish switch from ammonia to urea excretion if their habitat dries up and they are forced to burrow in the mud and become inactive.

16. In a cross between plants with purple- and white-colored flowers. The following results were obtained in the F1 generation (assume that both varieties are true breeding): 100 plants with white flowers; 150 straw yellow; 200 yellow; 245 greenish yellow; 500 green; 440 light blue; 400 blue; 300 indigo; 253 purple; and 100 dark purple. These data support which one of the following conclusions?

- (A) Flower color in this species does not follow Mendelian inheritance
- (B) Law of incomplete dominance
- (C) Colors are co-dominant in this species
- (D) Flower color in this species is determined by multiple genes

Ans D

Exp : Quantitative traits like color, height are determined by the additive action of multiple genes. The distribution of quantitative traits resembles the bell-shaped curve for a normal distribution.

17. Which one of the following is most crucial for the success of vaccination?

- (A) Antigen presentation by T helper cells
- (B) Complement system
- (C) Presence of long-lived antigen-specific lymphocytes
- (D) Selection of B cells in the lymphoid tissue

Ans C

Exp: Memory cells can initiate antibody-mediated immune response if they are stimulated by being bound to the antigen. They circulate more actively from blood to lymph and have long life spans (years or decades) and are responsible for rapid secondary response.