

## GATE LIFE SCIENCES 2009

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 (Biotechnology), K (Botany), L (Microbiology) 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. 6 carry one mark each.**

**Q.1** Pernicious anemia is due to

- (A) blockage of vitamin B<sub>12</sub> absorption.
- (B) blockage of vitamin A absorption.
- (C) deficiency of vitamin C.
- (D) deficiency of vitamin B<sub>2</sub>.

Ans A

Pernicious anemia is one type of megaloblastic anemias which is caused by the loss of gastric parietal cells. This leads to the lack of intrinsic factor which promotes the absorption of vitamin B<sub>12</sub> from the gut.

**Q.2** Which of these can be an antigen but cannot induce immune responses?

- (A) Hemocyanin
- (B) Influenza virus
- (C) Azobenzene arsonate
- (D) Corynebacteria

Ans C

Exp: P-Azobenzene arsonate is a hapten which capable of eliciting both antibody formation and delayed hypersensitivity when bound to aromatic amino acids, polypeptides or proteins. Haptens can elicit an immune response only when attached to a large carrier.

**Q.3** In mammals, the second messenger Nitric Oxide (NO) is produced from

- (A) Ammonium nitrate
- (B) Arginine
- (C) Urea
- (D) Nitrous acid

Ans B

Exp: Nitric oxide (NO) is synthesised from arginine and oxygen by the NO synthase and works through activation of soluble guanylyl cyclase, which when activated produces another second messenger, cGMP.

**Q.4** Generally, the rate-limiting step of major metabolic pathways is a reaction

- (A) in which the availability of the substrate is limited.
- (B) catalyzed by an allosteric enzyme.
- (C) catalyzed by an enzyme with very low  $K_m$ .
- (D) whose products are not readily consumed by the subsequent step of the pathway.

Ans C

Exp: The rate-limiting step of every metabolic pathway is far from equilibrium because of the relatively low activity of the enzyme that catalyzes it. The rate of this reaction is not limited by substrate availability, but only by the activity of this enzyme. Low  $K_m$  of enzyme indicates a high affinity between enzyme and substrate, meaning that the rate will approach  $V_{max}$  more quickly.

**Q.5** Phospholipases A1 and A2,

- (A) play no role in phospholipids synthesis.
- (B) hydrolyze phosphatidic acid to diglycerate.
- (C) remove fatty acid from sn-1 and sn-2 of phospholipids.
- (D) are involved in biosynthesis of phosphatidyl ethanolamine.

Ans C

Exp: A phospholipase is an enzyme that hydrolyzes phospholipids into fatty acids and other lipophilic substances. Within the class of Phospholipase A

- Phospholipase A1 - cleaves the SN-1 acyl chain.
- Phospholipase A2 - cleaves the SN-2 acyl chain, releasing arachidonic acid.

**Q.6** Equal volumes of two buffers of pH 4 and pH 6 of identical ionic strengths are mixed. The resultant pH is

- (A) close to 4.
- (B) close to 5.
- (C) close to 6.
- (D) exactly 5.

Ans A

Exp: The hydrogen ion concentration ( $[H^+]$  concentration (mol/l)) in a solution of pH 4 is 0.0001 ( $1 \times 10^{-4}$ ). Similarly the hydrogen ion concentration in a solution of pH 6 is 0.000001 ( $1 \times 10^{-6}$ ). When you add two solutions of identical ionic strengths (you get a mixture of all ions in the solution), the sum is equal to  $(0.0001 + 0.000001 = 0.000101)$ . 0.000101 is closer to 0.0001 and hence the pH is closer to 4.

**Q. 8 to Q.20 carry two marks each.**

**Q.8** The formation of ATP from ADP and  $P_i$  is not a spontaneous reaction. A reason for this is

- (A) ATP readily ionizes.
- (B) electrostatic repulsion in ATP is lower than that in ADP.
- (C) ATP is better hydrated than the total hydration levels of ADP and  $P_i$ .
- (D) resonance stabilization of P-O bonds in  $P_i$  is higher than that in ATP.

Ans D

Exp: ATP is an unstable molecule in and gets hydrolysed to ADP and phosphate easily. This is because the strength of the bonds between the phosphate groups in ATP are less than the strength of the hydrogen bonds (hydration bonds), between its products (ADP + phosphate), and water.

**Q.9** A beam of light passes through 1 cm of a colored solution. Eighty percent of the incident light is transmitted. If the incident light passes through 2 cm of the same solution, the percentage of transmitted light is

- (A) 60
- (B) 64
- (C) 70
- (D) 40

Ans A

Exp: According to the Law of absorption the amount of light absorbed is proportional to the thickness of the absorbing material and is independent of the intensity of the incident light.

**Q.10** Lactose uptake in *E. coli* is an example of

- (A) Passive transport
- (B) Primary active transport
- (C) Secondary active transport
- (D) Simple diffusion

Ans C

Exp: Symport (cotransport) carriers bind two dissimilar solutes (substrates) and transport them together across a membrane. Transport of the two solutes is obligatorily coupled. A gradient of one substrate, usually an ion, may drive uphill (against the gradient) transport of a co-substrate. It is sometimes referred to as secondary active transport. Example: Lactose permease catalyzes uptake of the disaccharide lactose into *E. coli* bacteria, along with  $H^+$ , driven by a proton electrochemical gradient.

**Q.11** During receptor-mediated endocytosis of LDL bound to its receptor

- (A) both receptor and ligand are degraded,
- (B) the receptor is degraded and the ligand is recycled.
- (C) both are recycled.
- (D) the ligand is degraded and the receptor is recycled.

Ans D

Exp: The receptor is recycled and returned to the plasma membrane to collect more LDL particles whereas the ligand or LDL is broken down to cholesterol, amino acids and fatty acids.

**Q.12** Choose the correct pairs from the following:

a. Isocitrate lyase	i. Conversion of amino acids into glucose
b. PEP carboxykinase	ii. Biotin
c. Pyruvate dehydrogenase complex	iii. Synthesis of glucose from acetate
d. Phosphofructokinase	iv. Lipoic acid
e. Pyruvate carboxylase	v. An allosteric enzyme

- (A) a-i, b-ii, c-iv, d-v, e-iii
- (B) a-iii, b-i, c-iv, d-v, e-ii

- (C) a-iii, b-i, c-iv, d-ii. e-v  
(D) a-ii, b-v, c-i, d-iv, c-iii

Ans B

**Q.13** The advantage of hemoglobin having a high histidine content is

- (A) histidine binds to oxygen.  
(B) histidine carries oxygen to the tissues.  
(C) histidine imparts buffering capacity to hemoglobin.  
(D) 'R' group of histidine has low pKa.

Ans C

Exp: As Histidine has a pKa near to the blood pH, it possesses a significant buffering action in blood. Hemoglobin contains a large number of histidine subunits in its structure.

**Q.14** IgG has four chains. Purified monoclonal IgG was subjected to electrophoresis. The number of bands visible by

- a) Reducing SDS-PAGE  
b) Isoelectric focusing  
c) Native PAGE  
are

- (A) a-2; b-1; c-1  
(B) a-1; b-1; c-2  
(C) a-2; b-4; c-2  
(D) a-4; b-2; c-4

Ans A

**Q.15** When E.coli is grown in glucose and lactose, the lac operon is not expressed. This is because glucose interferes with

- (A) removal of repressor.  
(B) binding of activator.  
(C) removal of repressor and binding of activator.  
(D) removal of activator.

Ans B

Exp: In the presence of glucose in the environment the following changes take place- Synthesis of adenylcyclase is inhibited, cAMP production drops down,

(cAMP – CAP) complex does not form, CAP (activator protein) fails to bind to the promoter sequence, Transcription of lac operon does not take place.

**Q.16** What property of biomembranes is responsible for their self-sealing nature?

- (A) Hydrophilicity of the phospholipid head group
- (B) Presence of proteins in biomembranes
- (C) Presence of cholesterol in biomembranes
- (D) Hydrophobicity of the fatty acid side chains of phospholipids

Ans D

Exp: Hydrophobicity of the fatty acid side chains of phospholipids imparts the ability to self seal (always form closed compartments) to Biomembranes.

**Q.17** A mixture of amino acids consisting of glycine, lysine, arginine, histidine, aspartic acid and glutamic acid was placed in the centre of a paper strip, moistened with buffer of pH 6 and electric current applied. The migration of amino acids was as follows:

- (A) Glycine, lysine and histidine moved towards the anode. Aspartic acid and glutamic acid moved towards the cathode while arginine remained near the origin.
- (B) Aspartic acid and glutamic acid remained near the origin and lysine, histidine and glycine moved towards the anode while arginine moved towards the cathode.
- (C) Glycine remained near the origin. Lysine, arginine and histidine moved towards the cathode while aspartic acid and glutamic acid moved towards the anode.
- (D) All amino acids remained near the origin.

Ans C

**Q.18** Cells expressing Epidermal Growth Factor (EGF) receptors were treated (T) or untreated (U) with EGF. The cells were lysed and immunoprecipitated with EGF receptor-specific antibodies. The immunoprecipitate was analyzed by Western blotting with antibodies specific to

i) phosphotyrosine ii) phosphothreonine iii) tyrosine kinases iv) threonine kinases. Which of these antibodies would detect a band under T and U conditions?

- (A) T- i & iii; U- iii
- (B) T- ii & iv; U- iv
- (C) T- i & ii; U- i
- (D) T- i & iii; U-ii

Ans A

Exp: EGFR is a tyrosine kinase receptor hence after treatment with EGF it produces phosphorylated tyrosine residues.

**Q.19** Which of the following would be considered the longest feedback loop?

- (A) Reproductive steroid hormones ----- aminergic neurons
- (B) Reproductive steroid hormones ----- hypothalamic neurons
- (C) Reproductive steroid hormones ----- pituitary gonadotrophs
- (D) Gonadotropin releasing hormone ----- hypothalamic neurons

Ans A

**Q.20** In myasthenia gravis, a neuromuscular disorder, the acetylcholine receptor becomes dysfunctional because

- (A) the receptor is mutated.
- (B) antibodies to the receptor inhibit ligand binding.
- (C) of deficiency in acetylcholine transferase.
- (D) of excess of acetylcholine esterase.

Ans A

Exp: Autoantibodies are produced against acetyl choline receptors and thereby inhibit the ligand binding.

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## BIOTECHNOLOGY

**Q. 1 - Q. 7 carry one mark each.**

**Q.1** The method used for prediction of three dimensional structure of a protein from known structure(s) of one or more related proteins is

- (A) Multiple sequence alignment
- (B) Homology modeling
- (C) Phylogeny
- (D) Docking

Ans B

Exp: Homology modeling, also termed comparative modeling or knowledge-based modeling, develops a three-dimensional model from a protein sequence based on the structures of homologous proteins.

**Q.2** To produce plants that are homozygous for all traits, the best choice is

- (A) Protoplast culture
- (B) Cell suspension culture
- (C) Anther and pollen culture
- (D) Apical meristem culture

Ans C

Exp: Anther and pollen culture helps to produce haploid plants containing a single set of chromosomes. Haploid plants can be used to produce homozygous diploid or polyploid plants which are valuable for breeding.

**Q.3** Restriction endonucleases from two different organisms that recognize the same DNA sequence for cleavage are called

- (A) Isoschizomers
- (B) Isozymes
- (C) Concatamers
- (D) Palindromes

Ans A

**Q.4** Caspases are involved in the process of

- (A) DNA replication
- (B) Mutation and recombination
- (C) Antibody synthesis
- (D) Apoptosis

Ans D

Exp: Caspases, or cysteine-aspartic proteases are a family of cysteine proteases that play essential roles in apoptosis.

**Q.5** Baculovirus expression system is used to express heterologous genes in

- (A) Mammals
- (B) Plants
- (C) Insects
- (D) Yeasts

Ans C



Exp: The most commonly used vector system for recombinant protein expression in insect is baculovirus, although baculoviral also can be used for gene transfer and expression in mammalian cells

**Q.6** A culture vessel in which physical, physicochemical and physiological conditions, as well as cell concentration, are kept constant is known as

- (A) Cell concentrator
- (B) Biostat
- (C) Batch bioreactor
- (D) Incubator

Ans C

**Q.7** Virus resistant transgenic plants can be developed by the expression of

- (A) Cowpea trypsin inhibitor
- (B) Crystalline toxin protein
- (C) Defective movement protein
- (D) Snowdrop lectin

Ans B

Exp: The proteins on the surface of the capsid and envelope of a virus determine the interaction of the virus with the host and elicit the protective immune response against the virus. Engineering of virus resistant transgenic plants involves either countering the capsid properties (toxin proteins) or dis-rupting the virus replicating mechanisms in the host.

**Q. 8 to Q.18 carry two marks each.**

**Q.8** Which of the following are commonly used as reporter genes?

- P) NPT gene
- Q) Luciferase gene
- R) CFTR gene
- S) GFP gene

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

Ans A

Exp: Reporter gene assay measures the regulatory potential of an unknown DNA-sequence by linking its promoter sequence to an easily detectable reporter gene. Commonly used reporter genes include the gene that encodes jellyfish green fluorescent protein (GFP), which causes cells that express it to glow green under blue light, the enzyme luciferase, which catalyzes a reaction with luciferin to produce light in firefly.

**Q.9** Which of the following statements are true about glyphosate tolerant transgenic plants?

- P. Transgenic plants detoxify glyphosate.
- Q. Transgenic plants produce an altered enzyme that is not affected by glyphosate.
- R. Transgenic plants sequester glyphosate in vacuoles.
- S. Transgenic plants overcome the inhibition of aromatic amino acid biosynthesis.

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

Ans C

Exp: Glyphosate herbicide kills plants by blocking the EPSPS enzyme, an enzyme involved in the biosynthesis of aromatic amino acids, vitamins and many secondary plant metabolites. There are several ways by which crops can be modified to be glyphosate-tolerant. One strategy is to incorporate a soil bacterium gene that produces a glyphosate-tolerant form of EPSPS. Another way is to incorporate a different soil bacterium gene that produces a glyphosate degrading enzyme.

**Q.10** Match the items in Group 1 with an appropriate description in Group 2:

Group 1	Group 2
P. UPGMA Q. CLUSTAL R. SWISS-PROT S. RasMol	1. Protein sequence database 2. Phylogenetic analysis 3. 3-D structure visualization 4. Multiple sequence alignment

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

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

Ans B

**Q.11** Match the properties in Group1 with the downstream operations in Group2:

Group 1	Group 2
P. Size Q. Density R. Volatility S. Solubility	1. Extraction 2. Distillation 3. Filtration 4. Sedimentation

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

Ans B

**Q.12** Match the items in Group 1 with their functions in Group 2 :

Group 1	Group 2
P. <i>rol</i> genes Q. Opines R. Virulence genes S. <i>Aux</i> and <i>cyt</i> genes	1. Food and energy source 2. Tumor formation 3. Hairy root induction 4. T-DNA transfer and integration

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

Ans D

**Q.13** Which of the following statements hold true for pluripotent stem cells (PSCs) under *in vitro* conditions?

- P. PSCs can be maintained in an undifferentiated state.  
 Q. PSCs exhibit abnormal and unstable karyotypes.  
 R. PSCs can differentiate into a wide variety of cell types.  
 S. PSCs cannot be passaged continuously.

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

Ans A

**Q.14** Determine the correctness or otherwise of the following Assertion (a) and reason (r):

Assertion (a): IPTG (Isopropylthiogalactoside) is a gratuitous inducer of *lac* operon.

Reason (r): IPTG is an efficient inducer, but not a substrate of *lac* operon.

- (A) Both (a) and (r) are true and (r) is the correct reason for (a).
- (B) Both (a) and (r) are true but (r) is not the correct reason for (a).
- (C) (a) is true but (r) is false.
- (D) (a) is false but (r) is true.

Ans A

Exp: Any compound that causes the induction of gene expression and is not itself metabolized by the enzymes is known as gratuitous inducer. Example - The induction of the *lac* operon by isopropylthiogalactoside (IPTG).

**Q.15** Match the items in Group 1 with correct options in Group 2:

Group 1	Group 2
P. DNA footprinting Q. Yeast two-hybrid system R. DNA fingerprinting S. SAGE	1. Protein-protein interaction 2. VNTR 3. DNA binding protein 4. Transcriptome analysis

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

Ans B

**Q.16** Determine the correctness or otherwise of the following Assertion (a) and Reason (r):

Assertion (a): Bacterial growth is called synchronous when majority of the cells are in same stage of the bacterial cell cycle.

Reason (r): Synchronous culture can be obtained by growing bacteria in an enriched medium

- (A) Both (a) and (r) are true and (r) is the correct reason for (a).  
 (B) Both (a) and (r) are true but (r) is not the correct reason for (a).  
 (C) (a) is true but (r) is false.  
 (D) (a) is false but (r) is true.

Ans C

Exp: Out of the several methods used to obtain the synchronous growth, one method is to eliminate an essential nutrient from the growth medium and later to re-introduce it.

**Q.17** Match the products in Group 1 with their possible applications in Group 2:

Group 1	Group 2
P. Erythropoietin Q. Anti-fibrin 99 R. Collagenase S. Transferrin	1. Blood clot 2. Binding and transport of iron 3. Anaemia 4. Animal cell separation

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

Ans A

**Q. 18** Match the products in Group 1 with their producer organisms in Group 2:

Group 1	Group 2
P. Ethanol from glucose Q. Probiotics R. Citric acid S. Sauerkraut	1. <i>Aspergillus niger</i> 2. <i>Leuconostoc mesenteroides</i> 3. <i>Saccharomyces cerevisiae</i> 4. <i>Bifidobacterium</i>

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

(D) P-1, Q – 4, R- 3, S-2

Ans B

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## BOTANY

**Q. 1 - Q. 6 carry one mark each.**

**Q.1** Kyoto Protocol is related to

- (A) Acid rain
- (B) Photochemical smog
- (C) Ozone hole
- (D) Global warming

Ans D

Exp: Kyoto Protocol sets binding targets for 37 industrialized countries and the European community for reducing greenhouse gas (GHG) emissions which in turn lead to global warming.

**Q.2** Phagotrophs are

- (A) Organisms that feed on dead organic matter
- (B) Organisms that absorb dissolved organic matter
- (C) Organisms that ingest other organisms or particulate organic matter
- (D) Organisms that manufacture food from simple inorganic substances

Ans C

**Q.3** Choose the correct relation between Angstrom (°A) and nanometer (nm)

- (A)  $1^{\circ}\text{A} = 10^1 \text{ nm}$
- (B)  $1^{\circ}\text{A} = 10^{-1} \text{ nm}$
- (C)  $1^{\circ}\text{A} = 10^{-2} \text{ nm}$
- (D)  $1^{\circ}\text{A} = 10^2 \text{ nm}$

Ans B

**Q.4** In hypogynous flower

- (A) Ovary occupies the highest position on the thallamus
- (B) Ovary may be partially sunken in the thallamus
- (C) Ovary is completely sunken in the thallamus
- (D) Ovary is naked

Ans A

Exp: A hypogynous flower shows a superior ovary which is attached to the receptacle above the attachment of other floral parts

**Q.5** Fill up the blanks with appropriate matches.

The main axis of the inflorescence is known as \_\_\_\_\_ and the stalk of the individual flower is called \_\_\_\_\_.

- (A) Pedicel and Panicle
- (B) Panicle and Pedicel
- (C) Pedicel and Peduncle
- (D) Peduncle and Pedicel

Ans D

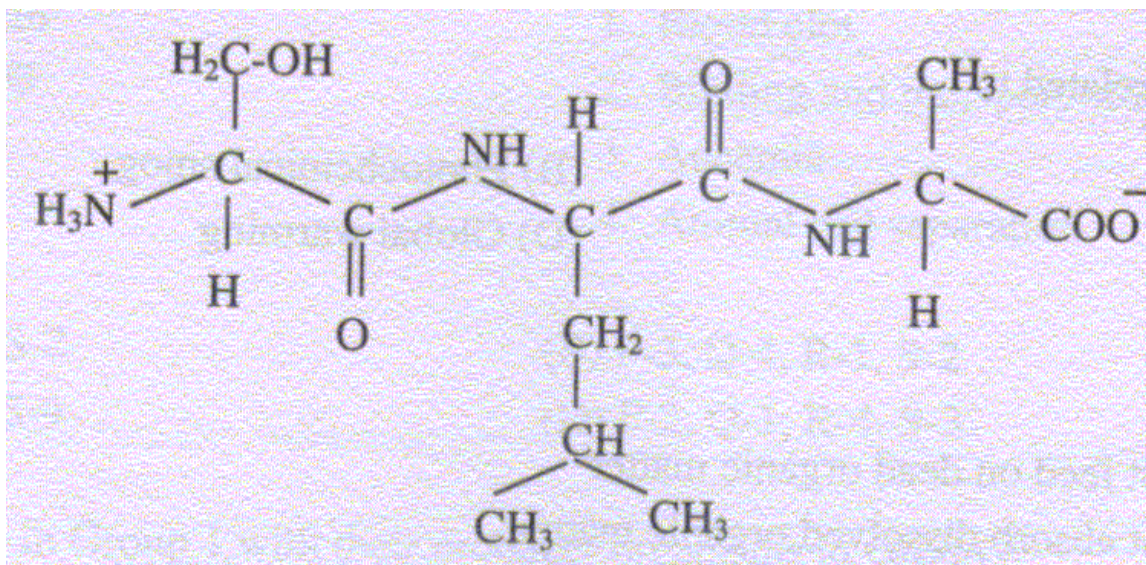
**Q.6** Microorganisms responsible for nitrification

- (A) *Nitrosomonas* and *Nitrobacter*
- (B) *Nostoc* and *Anabaena*
- (C) *Rhizobium* and *Azotobacter*
- (D) *Clostridium* and *Pseudomonas*

Ans A

**Q. 8 to Q.12** carry two marks each.

**Q.8** Identify the amino acids in the following peptide chain:



- P. Iso-Leu-Ala  
 Q. Leu-Iso-Asn  
 R. Ser-Leu-Ala  
 S. Ser-Pro-Gln

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

Ans R

**Q. 9** Which of the following statements are INCORRECT ?

- P. The frequency of recombination is a measure of linkage between genes on the same chromosome.  
 Q. DNA polymerase I is the true DNA replicase in E.coli.  
 R. The conserved element closest to the transcription initiation site is called the CAAT box.  
 S. The introns in the nuclear pre-mRNAs are excised by spliceosomes.

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

Ans B

**Q.10** Identify the pathways where the following reactions occur:

Group 1	Group 2
P. Fatty acid + GTP + Co A =Acyl-CoA + GDP + Pi Q. NH <sub>3</sub> + Glutamate + ATP = Glutamine +ADP + Pi R. Succinate + E - FAD = Fumarate + E — FADH <sub>2</sub> S. Malonyl-S-CoA + ACP-SH = Malonyl-S-ACP + CoA-SH	1. Fatty acid synthesis 2. Fatty acid oxidation 3. Oxidative phosphorylation 4. Citric acid cycle 5. Gluconeogenesis 6. Amino acid biosynthesis

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



(D) P-2, Q-6, R-4, S-1

Ans D

Q.11

	Group I	Group II
P.	$\begin{array}{c} \downarrow \\ \text{AG} \bullet \text{CT} \\ \text{TC} \uparrow \text{GA} \end{array}$	1. <i>EcoRI</i>
Q.	$\begin{array}{c} \downarrow \\ \text{GTPy} \bullet \text{PuAC} \\ \text{CAPu} \uparrow \text{PyTG} \end{array}$	2. <i>AluI</i>
R.	$\begin{array}{c} \downarrow \\ \text{C} \text{ C} \bullet \text{GG} \\ \text{GG} \text{ C} \uparrow \text{C} \end{array}$	3. <i>HpaII</i>
S.	$\begin{array}{c} \downarrow \\ \text{A} \text{AG} \bullet \text{CTT} \\ \text{TTC} \text{ GA} \uparrow \text{A} \end{array}$	4. <i>HindIII</i>
		5. <i>PstI</i>
		6. <i>HincII</i>

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

Ans B

Q.12

Group 1	Group 2
P. Linnaeus Q. William Roxburgh R. Bentham-Hooker S. Engler	1. <i>Flora Indica</i> 2. <i>Genera Plantarum</i> 3. Artificial-sexual system 4. Sero diagnostic system 5. Phylogenetic system 6. <i>The Families of Flowering Plants</i>

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

Ans D

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## MICROBIOLOGY

**Q.1-- Q. 6 carry one mark each.**

**Q.1** Which of the following scientists are associated with the discoveries listed below:

1. Identification of DNA as the genetic material	a. Fleming
2. Discovery of penicillin	b. Avery
3. Demonstration of bacterial transformation	c. Beijerinck
4. Demonstration of filterable infectious agent	d. Griffith

- (A) 1-b,2-a,3-d,4-c
- (B) 1-b,2-c,3-a,4-d
- (C) 1-b,2-d,3-a,4-c
- (D) 1-b,2-a,3-c,4-d

Ans A

**Q.2** Density of cells of a bacterial culture is routinely measured using Spectrophotometer. This is based on the principle of

- (A) Light absorption
- (B) Light diffraction
- (C) Light scattering
- (D) Light reflection

Ans A

Exp: A spectrophotometer is used to measure the amount of light a sample (be it liquid or solid) absorbs.

**Q.3** Which one of the following life styles does Rhizobium species adopt to fix molecular nitrogen to ammonia?

- (A) Both symbiotic as well as non symbiotic
- (B) Only symbiotic
- (C) Only non-symbiotic
- (D) Only commensalism

Ans B

Exp: Legumes including peas, lentils and alfalfa can form symbiotic associations for nitrogen fixation with a soil bacterium called Rhizobium. The Rhizobium enters into the roots and forms nodules, which the bacteria then use as their home.

**Q.4** Identify the correct pair of amino acids which differ only by an atom in the side chain (R) group.

- (A) Gly-Ala
- (B) Ser-Cys
- (C) Met-Leu
- (D) Ser-Asp

Ans B

**Q.5** Which one of the following antibiotics inhibits protein biosynthesis precisely by blocking the peptidyl transfer stage?

- (A) Bleomycin
- (B) Rifampicin
- (C) Chloramphenicol
- (D) Tetracycline

Ans C

**Q.6** Pseudopeptidoglycan is present in the cell wall of

- (A) *Escherichia coli*
- (B) *Bacillus subtilis*
- (C) *Saccharomyces cerevisiae*
- (D) *Methanococcus jannaschii*

Ans D

Exp: Pseudopeptidoglycan is a major cell wall component of some archaea. The basic components of Pseudopeptidoglycan are N-acetylglucosamine and N-acetylglucosaminuronic acid (Peptidoglycan has N-acetylmuramic acid instead), which are linked by a  $\beta$ -1,3-glycosidic bond.

**Q. 8 to Q.13 carry two marks each.**

**Q.8** Which one of the following approaches would be appropriate if one wants to cultivate microorganisms under constant physiological conditions.

- (A) Fed batch culture
- (B) Batch culture
- (C) Continuous culture
- (D) Discontinuous culture

Ans B

Exp: A culture vessel in which physical, physicochemical and physiological conditions, as well as cell concentration, are kept constant is known as Batch Bioreactor.

**Q.9** A silent mutation is one that

- (A) results in a truncated polypeptide
- (B) replaces an amino acid with an equivalent amino acid in a polypeptide
- (C) does not change the amino acid sequence of the polypeptide
- (D) changes the reading frame of the mRNA leading to an altered polypeptide

Ans C

Exp: Silent mutations are DNA mutations that do not result in a change to the amino acid sequence of a protein. They may occur in a non-coding region (outside of a gene or within an intron), or they may occur within an exon in a manner that does not alter the final amino acid sequence.

**Q. 10** The rotatory motion of bacterial flagellum is driven by

- (A) energy obtained through hydrolysis of ATP
- (B) trans-membrane electrochemical potential linked to proton pumping
- (C) direct uptake of extra-cellular nutrients
- (D) concentration gradient of nutrients in the environment

Ans A

**Q.11** RecA is a protein involved in

- (A) Recombinational repair
- (B) Mismatch repair
- (C) Nucleotide excision repair
- (D) Base excision repair

Ans A

Exp: RecA is a protein in *E. coli* involved in recombinational repair of damaged DNA and in SOS repair. RecA catalyzes strand pairing, or strand assimilation-the joining of two different DNAs by homologous base pairing with each other.

**Q.12** In which of the following bacterium, chemical energy is converted to both mechanical as well as light- energy?

- (A) *Vibrio fischeri*
- (B) *Bacillus subtilis*.
- (C) *Escherichia coli*
- (D) *Pseudomonas fluorescense*

Ans D

**Q.13** Effective chemotherapeutic agents are difficult to develop for the treatment of fungal infections because

- (A) Fungi have cell wall.
- (B) Fungi have better mechanisms to inactivate drugs.
- (C) Fungi are eukaryotic cells and their cellular machinery is similar to that of the host.
- (D) Fungal pathogens typically infect organs inaccessible for antibiotic treatment.

Ans A

Fungi are eukaryotic and are composed of rigid cell wall largely made of chitin which is a polymer of N-acetylglucosamine rather than peptidoglycan which is a characteristic component of most bacterial cell walls

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## ZOOLOGY

**Q. 1 - Q. 5 carry one mark each.**

**Q.1.** In a normal animal cell, the extra-chromosomal DNA is

- (A) Single stranded circular
- (B) Single stranded linear
- (C) Double stranded circular
- (D) Double stranded linear

Ans C

**Q.2** During hibernation in a hibernating mammal, its body temperature would be

- (A) Lower than normal state
- (B) Same as normal state
- (C) Higher than normal state
- (D) Fluctuate between high and low points

Ans A

Exp: Hibernation is a state of inactivity and metabolic depression in animals, characterized by lower body temperature, slower breathing, and lower metabolic rate.

**Q.3** Mendel's principle of segregation means that the germ cells (egg or sperm) always receive

- (A) One of the paired alleles
- (B) One pair of alleles
- (C) One quarter of the genes
- (D) Any pair of alleles

Ans A

Exp: The Law of Segregation states that every individual possesses a pair of genes for any particular trait and that each parent passes a randomly selected copy of only one of these to its offspring through eggs or sperms.

**Q.4** Which of the following statements does NOT describe the characteristics of human population in industrialized countries?

- (A) Relatively small family size
- (B) Relatively even age structure
- (C) Rapid reproduction rate
- (D) Delayed reproduction

Ans C

**Q.5** Sex-linkage refers to

- (A) Inheritance of genes linked to sex determination
- (B) The ratio of genes on the autosome and sex chromosomes
- (C) Inheritance of genes carried on the sex chromosomes
- (D) Linkage of genes present on the sex chromosomes

Ans A

Exp: Sex linkage is the phenotypic expression of an allele related to the chromosomal sex of the individual.

**Q. 8 to Q.13 carry two marks each.**

**Q.8** Increase in the emission of fossil fuels is thought to result in global warming. This is possible because an increase in atmospheric CO<sub>2</sub>, level would

- (A) Increase the amount of sun light entering the earth atmosphere
- (B) Increase the amount of infrared radiation entering the earth
- (C) Absorb the infrared radiation reflected by the earth
- (D) Insulate earth from cold breeze coming from the space

Ans B

Exp: The atoms of Carbon dioxide, absorb infrared radiation and the molecule starts to vibrate. Eventually, the vibrating molecule will emit the radiation again, and it will likely be absorbed by yet another greenhouse gas molecule. This absorption-emission-absorption cycle serves to keep the heat near the surface, effectively insulating the surface from the cold of space.

**Q.9** Anabolic steroids, taken illegally by sportspersons to enhance their physical strength, are synthetic analogues for natural \_\_\_\_\_ from the \_\_\_\_\_.

- (A) testosterone ....., anterior pituitary
- (B) FSH and LH ..... posterior pituitary
- (C) cortisol ....., thyroid
- (D) androgen ..... gonads

Ans A

Exp: They are drugs which mimic the effects of the male sex hormones: testosterone and dihydrotestosterone. They increase protein synthesis within cells, which results in the buildup of cellular tissue (anabolism), especially in muscles.

**Q. 10** Homology in anatomical parts helps in determining evolutionary kinship because

- (A) Homologous body parts invariably perform similar functions
- (B) Display evolutionary adaptations
- (C) Undergo similar genetic changes
- (D) Have common embryological origin

Ans D

Exp: Homologous structures are similar in different species because the species have common descent. They may or may not perform the same function. An example is the forelimb structure shared by cats and whales.

**Q.11** Which of the following does NOT explain the term "survival of the fittest"?

- (A) Fittest animals leave higher number of progeny than those which perish.
- (B) Fittest group of animals out populates its competitors.
- (C) Fittest animals are best predators.
- (D) Fittest group is rich in genetic variations.

Ans C

**Q.12** The human immune system is able to mount a response when it encounters a novel microorganism for the first time because

- (A) White blood cells are able to change their antigen specificity depending upon the microorganism they interact with.
- (B) Our body contains millions of different kinds of white blood cells, each with a unique type of antigen receptor.
- (C) Bone marrow cells make different antigen receptors depending upon the kind of invading microorganism.
- (D) Bone marrow cells are able to change their antigen specificity upon physical interaction with the microorganism.

Ans C

Exp: The clonal selection hypothesis states that the germline encodes many different antigen receptors - one for each antigenic determinant to which an individual will be capable of mounting an immune response.

**Q.13** Acetylcholinesterase is an enzyme that degrades acetylcholine. What would be the effect of administration of an inhibitor of acetylcholinesterase on nerve transmission?

- (A) No effect.
- (B) Synaptic transmission will be prevented.
- (C) Extra excitatory postsynaptic potentials would occur in the postsynaptic neuron,
- (D) The presynaptic neuron will be inactivated.

Ans D

Exp: The enzyme acetylcholinesterase breaks down acetylcholine and its breakdown products are absorbed by the pre-synaptic neuron by endocytosis



and used to re-synthesise more neurotransmitter, using energy from the mitochondria. This stops the synapse being permanently on.