

# GATE 2013 Question Paper (Life Sciences - XL)

EE25BTECH11019

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## General Aptitude (GA)

**Q. 1 – Q. 5 carry one mark each.**

**Q.1** If  $3 \leq X \leq 5$  and  $8 \leq Y \leq 11$  then which of the following options is TRUE? (GATE XL 2013)

1.  $X + Y \leq 13$
2.  $X - Y \leq -3$
3.  $X \cdot Y \leq 55$
4.  $X + Y \leq 16$

**Q.2** The Headmaster \_\_\_\_\_ to speak to you.  
Which of the following options is incorrect to complete the sentence? (GATE XL 2013)

1. is wanting
2. wants
3. want
4. was wanting

**Q.3** Mahatma Gandhi was known for his humility as (GATE XL 2013)

1. he played an important role in humiliating exit of British from India.
2. he worked for humanitarian causes.

3. he displayed modesty in his interactions.
4. he was a fine human being.

**Q.4** All engineering students should learn mechanics, mathematics and how to do computation.

Which of the underlined parts is not appropriate? (GATE XL 2013)

1. *I*
2. *II*
3. *III*
4. *IV*

**Q.5** Select the pair that best expresses a relationship similar to that expressed in the pair:

**water : pipe ::** (GATE XL 2013)

1. cart : road
2. electricity : wire
3. sea : beach
4. music : instrument

**Q. 6 – Q. 10 carry two marks each.**

**Q.6** Velocity of an object fired directly in upward direction is given by  $V = 80 - 32t$ , where  $t$  (*time*) is in seconds. When will the velocity be between 32 m/s and 64 m/s? (GATE XL 2013)

1.  $\left(1, \frac{3}{2}\right)$
2.  $\left(\frac{1}{2}, 1\right)$
3.  $\left(\frac{1}{2}, \frac{3}{2}\right)$
4.  $(1, 3)$

**Q.7** In a factory, two machines  $M_1$  and  $M_2$  manufacture 60% and 40% of the auto components respectively. Out of the total production, 2% of  $M_1$  and 3% of  $M_2$  are found to be defective. If a randomly drawn auto component from the combined lot is found defective, what is the probability that it was manufactured by  $M_2$ ? (GATE XL 2013)

1. 0.35
2. 0.45
3. 0.5
4. 0.4

**Q.8** Following table gives data on tourists from different countries visiting India in the year 2011: (GATE XL 2013)

Country	Number of Tourists
USA	2000
England	3500
Germany	1200
Italy	1100
Japan	2400
Australia	2300
France	1000

Which two countries contributed to one third of the total number of tourists who visited India in 2011?

1. USA and Japan
2. USA and Australia
3. England and France
4. Japan and Australia

**Q.9** If  $|-2X + 9| = 3$  then the possible value of  $|-X| - X$  would be: (GATE XL 2013)

1. 30
2. -30

3. -42

4. 42

**Q.10** All professors are researchers.  
Some scientists are professors.  
Which of the given conclusions is logically valid and is inferred from the above arguments? (GATE XL 2013)

1. All scientists are researchers
2. All professors are scientists
3. Some researchers are scientists
4. No conclusion follows

## Section H: Chemistry

**Q. 1 – Q. 5 carry one mark each.**

**Q.1**  $\text{N}(\text{CH}_3)_3$  and  $\text{N}(\text{SiH}_3)_3$  are congeners, but around N-atom the former has pyramidal geometry whereas the latter is nearly planar. The bonding responsible for planarity of  $\text{N}(\text{SiH}_3)_3$  is (GATE XL 2013)

1.  $p\pi-p\pi$
2.  $p\pi-d\pi$
3.  $d\pi-d\pi$
4.  $\delta$

**Q.2** The type of electronic transition responsible for the yellow colour of  $\text{K}_2\text{CrO}_4$  is (GATE XL 2013)

1. metal to ligand charge transfer
2. ligand to metal charge transfer
3. intra-ligand charge transfer
4. d-d transition

**Q.3** The given equation  $\frac{d(\Delta H)}{dT} = \Delta C_p$  where  $H$ ,  $T$ , and  $C_p$  are the enthalpy, temperature and heat capacity at constant pressure, respectively, is called (GATE XL 2013)

1. Clausius-Clapeyron equation
2. Hess's law
3. Kirchhoff's equation
4. Trouton's rule

**Q. 4 – Q. 5 are questions with numerical answer**

**Q.4** The number of 2-center–2-electron bonds in anhydrous  $\text{AlCl}_3$  is \_\_\_\_\_ (GATE XL 2013)

**Q.5** When dissolved in water, the number of  $\text{H}^+$  ions released from a molecule of  $\text{H}_3\text{BO}_3$  is \_\_\_\_\_ (GATE XL 2013)

**Q. 6 – Q. 15** carry two marks each.

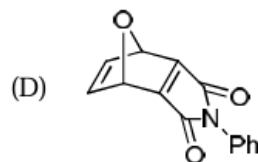
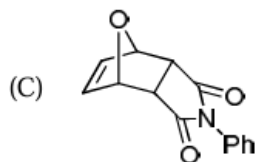
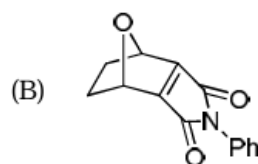
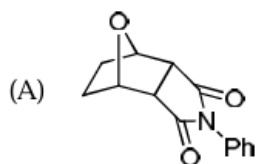
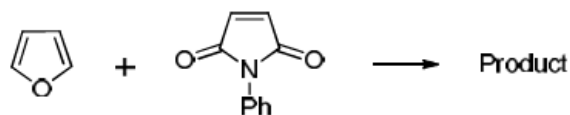
**Q.6** In NaCl crystal, the arrangement and coordination number of the ions are (GATE XL 2013)

1. fcc and 6
2. fcc and 4
3. hcp and 6
4. hcp and 4

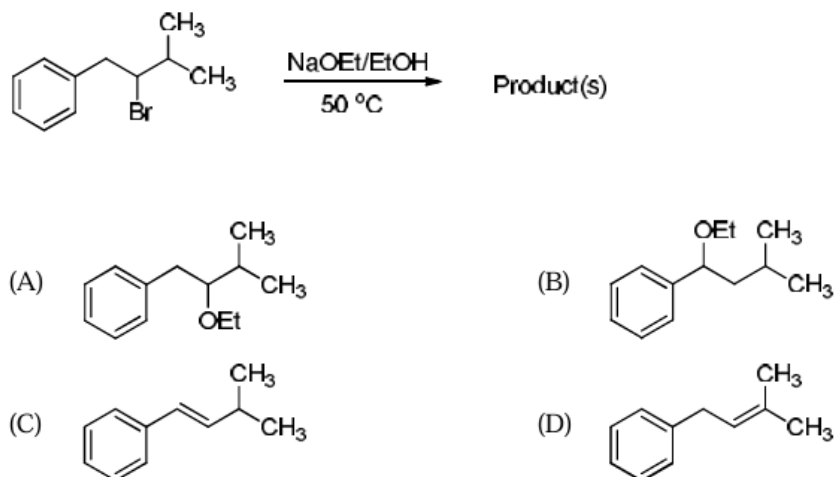
**Q.7** The solubility product ( $K_{sp}$ ) of  $\text{Ca}_3(\text{PO}_4)_2$  is  $1.3 \times 10^{-32}$ . In a 0.02 M solution of  $\text{Ca}(\text{NO}_3)_2$ , the solubility of  $\text{Ca}_3(\text{PO}_4)_2$  (in units of M) is (GATE XL 2013)

1.  $6.5 \times 10^{-9}$
2.  $1.6 \times 10^{-9}$
3.  $8.0 \times 10^{-9}$
4.  $4.0 \times 10^{-9}$

**Q.8** Identify the **CORRECT** product in the following reaction: (GATE XL 2013)



**Q.9** The major product obtained in the following reaction is:(GATE XL 2013)



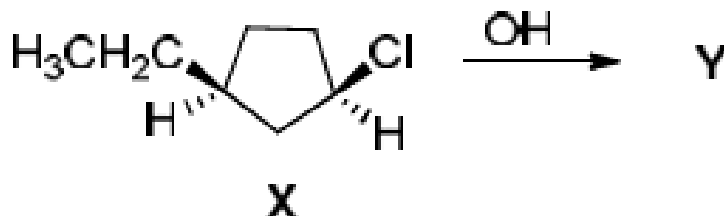
**Q. 10 – Q. 11 are questions with numerical answer.**

**Q.10** Iodine forms an anionic species Q in aqueous solution of iodide ( $I^-$ ). The number of lone pair(s) of electrons on the central atom of Q is \_\_\_\_\_ (GATE XL 2013)

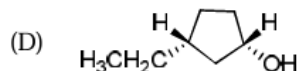
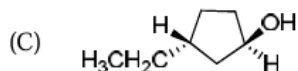
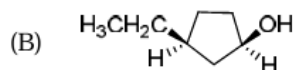
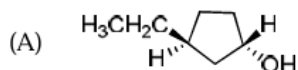
**Q.11** The rate of a chemical reaction is tripled when the temperature of the reaction is increased from 298 K to 308 K. The activation energy (in  $\text{kcal mol}^{-1}$ , up to one decimal place) for the reaction is (Given  $R = 1.987 \text{ cal mol}^{-1} \text{ K}^{-1}$ ): \_\_\_\_\_ (GATE XL 2013)

**Common Data for Questions 12 and 13:**

Consider the following  $S_N2$  reaction of optically pure 1-chloro-3-ethylcyclopentane (X).



**Q.12** The structure of **Y** in the above reaction is (GATE XL 2013)



**Q.13** The absolute configuration of 1-chloro-3-ethylcyclopentane shown above is (GATE XL 2013)

1. (1S,3R)
2. (1S,3S)
3. (1R,3R)
4. (1R,3S)

#### Linked Answer Questions

##### Statement for Linked Answer Questions 14 and 15:

The molar conductance at infinite dilution of sodium acetate, sodium sulfate and sulfuric acid solutions are  $91.0 \times 10^{-4}$ ,  $259.8 \times 10^{-4}$  and  $859.3 \times 10^{-4} \text{ S m}^2 \text{ mol}^{-1}$ , respectively.

**Q.14** The molar conductance at infinite dilution (in  $\text{S m}^2 \text{ mol}^{-1}$ ) of acetic acid is (GATE XL 2013)

1.  $1028 \times 10^{-4}$
2.  $820.4 \times 10^{-4}$
3.  $690.5 \times 10^{-4}$
4.  $390.8 \times 10^{-4}$

**Q.15** If the molar conductance of an acetic acid solution is  $15.2 \times 10^{-4} \text{ S m}^2 \text{ mol}^{-1}$ , then the percentage dissociation of acetic acid in the solution will be: (GATE XL 2013)

1. 3.89
2. 2.20



3. 1.85

4. 1.48

## Section I: Biochemistry

**Q. 1 – Q. 10 carry one mark each.**

**Q.1** Which one of the following statements is **TRUE** when a cell is kept in a hypotonic solution? (GATE XL 2013)

1. Water moves out of the cell
2. Size of the cell remains same
3. No movement of water takes place
4. Size of the cell increases

**Q.2** Which one of the following amino acids has a higher propensity for cis peptide bond formation? (GATE XL 2013)

1. Histidine
2. Cysteine
3. Glycine
4. Proline

**Q.3** The length of an  $\alpha$ -helix composed of 36 amino acid residues is (GATE XL 2013)

1. 10 Å
2. 54 Å
3. 27 Å
4. 360 Å

**Q.4** The order  $n$  for a given substrate concentration in an enzyme catalyzed reaction following Michaelis-Menten kinetics, is (GATE XL 2013)

1.  $n = 1$
2.  $n = 0$
3.  $n$  is not defined

4.  $0 \leq n \leq 1$

**Q.5** Which one of the following amino acid residues is specifically recognised by chymotrypsin during peptide bond cleavage? (GATE XL 2013)

1. Phe
2. Leu
3. Val
4. Asp

**Q.6** The terminal electron acceptor during mitochondrial respiration is (GATE XL 2013)

1.  $O_2$
2.  $FAD^+$
3.  $NAD^+$
4. ATP

**Q.7** During the biosynthesis of urea in the urea cycle, the two nitrogen atoms are derived from (GATE XL 2013)

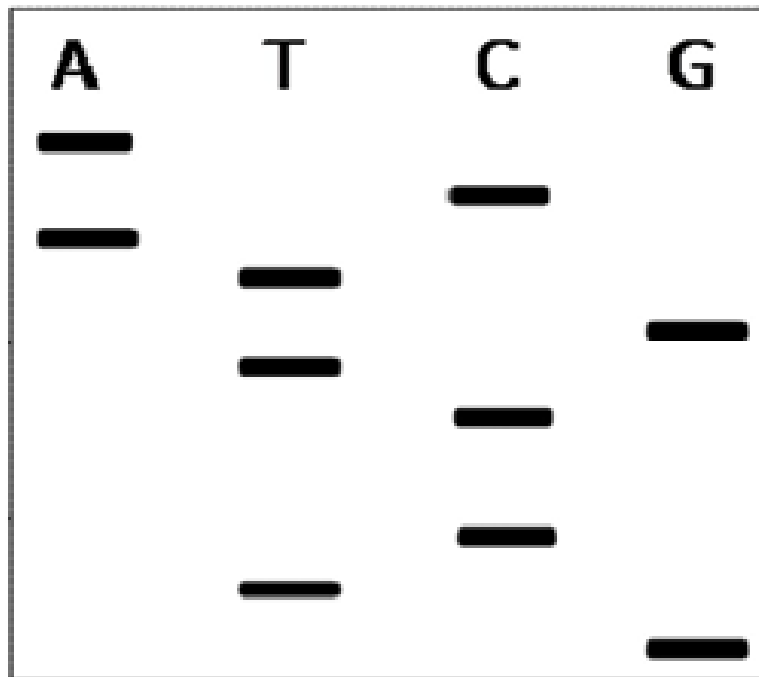
1. Two free ammonium groups
2. Free ammonium group and aspartate
3. Both nitrogen atoms are derived from arginine
4. One nitrogen atom from citrulline and one from glutamate

**Q.8** An enzyme has two binding sites for an inhibitor molecule. When the inhibitor binds to the first site, the dissociation constant of the inhibitor for the second site increases, leading to negative co-operativity. The Hill coefficient for such an inhibitor is (GATE XL 2013)

1. equal to one
2. greater than one
3. less than one

4. less than zero

**Q.9** An oligonucleotide was sequenced by the dideoxy method of Sanger and the following autoradiogram was obtained: (GATE XL 2013)



The sequence of the oligonucleotide is:

1. 3'-GTCCTGTACA-5'
2. 5'-GTCCTGTACA-3'
3. 5'-ACATGTCCTG-3'
4. 3'-AATTTCCCGG-5'

**Q.10** In different types of tissue transplantations, the rate of graft rejection in decreasing order is (GATE XL 2013)

1. Isograft > Xenograft > Allograft
2. Allograft > Isograft > Xenograft
3. Xenograft > Autograft > Allograft

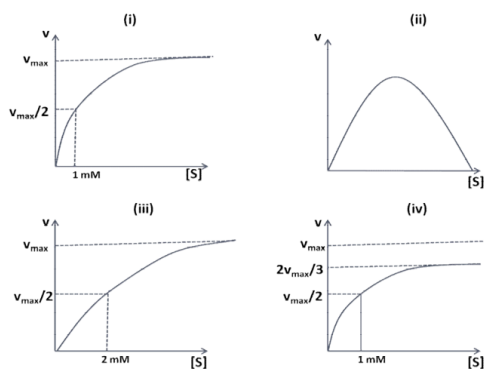
4. Xenograft > Allograft > Isograft

**Q. 11 – Q. 20 carry two marks each.**

**Q.11** You have prepared 1.0 liter of 0.5 M acetate buffer (pH = 5.0). The dissociation constant of acetic acid is  $1.7 \times 10^{-5}$  M. What would be the acetate ion concentration in the buffer? (GATEXL2013)

1. 0.1 M
2. 0.25 M
3. 0.315 M
4. 0.415 M

**Q.12** The following figures show the plot of reaction rate versus substrate concentration (mM) for an enzyme-catalyzed reaction in the presence and absence of an inhibitor. Match the possible reaction types with the plots. (GATEXL2013)



1. P-i, Q-iii, R-ii, S-iv
2. P-iii, Q-ii, R-i, S-iv
3. P-iii, Q-iv, R-i, S-ii
4. P-iv, Q-ii, R-i, S-iii

**Q.13** Arrange the following in the decreasing order of their permeability coefficients across a lipid bilayer membrane. (GATE XL 2013)

1. (i), (iii), (v), (ii), (iv)
2. (iii), (v), (ii), (iv), (i)
3. (iii), (i), (v), (ii), (iv)
4. (i), (iii), (iv), (v), (ii)

**Q.14** Arrange the following in the increasing order of amount of ATP generated by metabolism of one molecule of the following compounds:(*GATEXL2013*)

1. (ii), (iv), (iii), (i)
2. (iii), (ii), (i), (iv)
3. (iv), (ii), (i), (iii)
4. (iii), (ii), (iv), (i)

**Q.15** Match the following enzymes with their regulatory mechanisms:(*GATEXL2013*)

1. (a)-3, (b)-2, (c)-1, (d)-4
2. (a)-3, (b)-4, (c)-2, (d)-1
3. (a)-4, (b)-3, (c)-1, (d)-4
4. (a)-4, (b)-1, (c)-2, (d)-3

**Q.16** A researcher wants to clone 3 DNA fragments of sizes 1.1 Mb, 0.097 Mb and 0.045 Mb. The choice of the vectors for cloning each of the fragments are (*GATEXL2013*)

1. Cosmid, bacteriophage  $\lambda$ , bacteriophage P1
2. Yeast artificial chromosome, bacteriophage P1, cosmid
3. Bacterial artificial chromosome, bacteriophage  $\lambda$ , yeast artificial chromosome
4. Only plasmids

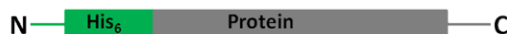
**Q.17** Which of the four restriction enzymes given below cut the following DNA sequence?

5'-CCGATATCTCGAGGGC-3'

(*GATEXL2013*)

1. P & Q
2. P, R & S
3. Q & S
4. P & R

**Q.18** You have expressed the following protein that has an isoelectric point of 6.0. The best order of protein purification methodologies to obtain a pure protein is? (GATEXL2013)



1. Gel filtration chromatography, Anion exchange chromatography at pH = 4.0, Ammonium sulphate precipitation
2. Cation exchange chromatography at pH = 9.0, Ni-affinity chromatography, Gel filtration chromatography
3. Anion exchange chromatography at pH = 8.0, Ni-affinity chromatography, Gel filtration chromatography
4. Ammonium sulphate precipitation, Anion exchange chromatography at pH = 4.0, Ni-affinity chromatography

**Q.19** An enzyme of 40 kDa is added to a substrate solution in a molar ratio of 1:3. The concentration of the enzyme in the mixture is 12 mg/ml. What would be the corresponding substrate concentration? (GATEXL2013)

1. 0.4 mM
2. 0.12 mM
3. 0.9 mM
4. 0.3 mM

**Q.20** A patient suffering from pneumonia and tuberculosis was found to have very low CD4<sup>+</sup> T cells. In all probability the **PRIMARY** causative infectious agent belongs to (GATEXL2013)

1. Klebsiella family
2. Mycobacterium family
3. Retrovirus family
4. Streptococcus family



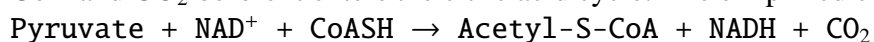
## Section J: Botany

**Q. 1 – Q. 10 carry one mark each.**

**Q.1** Bast fibres are present in (GATEXL2013)

1. Xylem
2. Phloem
3. Collenchyma
4. Parenchyma

**Q.2** During cellular respiratory process, pyruvate must be oxidized to acetyl CoA and CO<sub>2</sub> before it enters the citric acid cycle. The simplified equation is:



This oxidation occurs in mitochondria and is carried out by the enzyme: (GATE )

1. Pyruvate kinase
2. Pyruvate dehydrogenase
3. Pyruvate decarboxylase
4. Pyruvate carboxylase

**Q.3** Which of the following statements is **CORRECT**? (GATEXL2013)

1. The rice gene contains about 50,000 genomes on 12 chromosomes
2. The rice genome contains about 50,000 genes on 12 chromosomes
3. The rice chromosome contains about 50,000 genes on 12 genomes
4. The rice genome contains about 50,000 chromosomes on 12 genes

**Q.4** The aflatoxin found in post-harvested grains is injurious due to (GATEXL2013)

1. Aspergillus
2. Alternaria
3. Fusarium

4. Phytophthora

**Q.5** Identify the event that exclusively occurs in meiotic cell division:(*GATEXL2013*)

1. Chromatid formation
2. Spindle formation
3. Synapsis
4. Chromosome movement to pole

**Q.6** In nitrogen fixation, leghemoglobin helps in the presence of(*GATEXL2013*)

1. Nitrate synthetase
2. Nitrate synthase
3. Glutathione synthetase
4. Nitrogenase

**Q.7** Identify the **INCORRECT** statement: (*GATEXL2013*)

1. Detrital food chain energy flow is hard to measure
2. Ecological succession is change in community over time
3. Pollution reflects solar energy back, slowing warming
4. Photoperiodism has no relation to ecosystem

**Q.8** Two enzymes commonly used for plant protoplast isolation are(*GATEXL2013*)

1. Cellulase and Lipase
2. Cellulase and Amylase
3. Pectinase and Cellulase
4. Pectinase and Lipase

**Q.9** For successful transfer of a gene using Ti-plasmid, essential components  
are (*GATEXL2013*)

1. Opine catabolism genes, Left border, Right border
2. Opine catabolism genes, Left border, Virulence genes
3. Hormone genes, Right border, Virulence genes
4. Left border, Right border, Virulence genes

**Q.10** In cytoplasmic male sterility, the determinant is located in (GATEXL2013)

1. Chloroplast
2. ER
3. Golgi
4. Mitochondria

**Q. 11 – Q. 20 carry two marks each.**

**Q.11** Match the floral formula with family and species: (GATEXL2013)

1. P-1-iv, Q-2-iii, R-6-i, S-4-ii
2. P-2-v, Q-4-vi, R-3-iii, S-5-iv
3. P-3-v, Q-6-iii, R-5-i, S-2-ii
4. P-3-vi, Q-4-i, R-1-v, S-5-ii

**Q.12** A plant of genotype GGHH is crossed with gghh. If F<sub>1</sub> is test-crossed, what percentage of progeny will be gghh in these cases? (GATEXL2013)

1. P-25, Q-25, R-25, S-25
2. P-25, Q-50, R-45, S-38
3. P-50, Q-50, R-90, S-76
4. P-25, Q-50, R-10, S-24

**Q.13** Which two statements are **CORRECT**? (GATEXL2013)

1. P,Q

2. Q,R

3. R,S

4. P,S

**Q.14** Match the natural products: (GATEXL2013)

1. P-3-iv, Q-4-ii, R-2-v, S-6-i

2. P-2-iii, Q-3-i, R-1-iv, S-5-v

3. P-3-iv, Q-4-ii, R-2-v, S-6-i

4. P-4-iii, Q-1-v, R-5-i, S-2-vi

**Q.15** Which two statements are **INCORRECT**? (GATEXL2013)

1. P,Q

2. Q,R

3. Q,S

4. P,R

**Q.16** Which of the following are synthetic analogues of auxin and cytokinin?  
(GATEXL2013)

1. IAA and Kinetin

2. 2,4-D and Zeatin

3. IAA and Zeatin

4. 2,4-D and Kinetin

**Q.17** Which two statements are **INCORRECT**? (GATEXL2013)

1. P,R

2. Q,S

3. Q,R

4. P,S

**Q.18** Identify two **CORRECT** traits for: (GATEXL2013)

1. P-1,3; Q-2,4
2. P-2,4; Q-1,3
3. P-1,4; Q-2,3
4. P-2,3; Q-1,4

**Q.19** Match the enzyme terms: (GATEXL2013)

1. P-4, Q-5, R-2, S-3
2. P-4, Q-3, R-1, S-2
3. P-4, Q-3, R-5, S-6
4. P-4, Q-1, R-3, S-5

**Q.20** Choose two **CORRECT** statements on ion transport in roots:(GATEXL2013)

1. P,S
2. Q,R
3. R,S
4. Q,S

## Section K: Microbiology

**Q. 1 – Q. 10 carry one mark each.**

1. In 1976, Tonegawa's experiment gave clue about gene rearrangement during differentiation of B-cells. The two different types of cells used in this experiment were

- (a) HeLa cells and fibrosarcoma cells
- (b) embryonic cells and fibroblasts
- (c) adult myeloma cells and HeLa cells
- (d) embryonic cells and adult myeloma cells

(GATE XL 2013)

2. To which one of the following groups, the antibiotics kanamycin, streptomycin and gentamicin belong?

- (a) cephalosporins
- (b) macrolides
- (c) aminoglycosides
- (d) quinolones

(GATE XL 2013)

3. Shine Dalgarno's sequence present in mRNA binds to

- (a) 3' end of rRNA
- (b) 5' end of rRNA
- (c) 5' end of tRNA
- (d) 3' end of tRNA

(GATE XL 2013)

4. Which one of the following transport mechanisms is NOT employed by prokaryotes?

- (a) Passive diffusion

- (b) Group translocation
- (c) Endocytosis
- (d) Active transport

(GATE XL 2013)

5. The most common indicator organism of faecal pollution in water is

- (a) *Clostridium botulinum*
- (b) *Bacillus subtilis*
- (c) *Escherichia coli*
- (d) *Clostridium tetani*

(GATE XL 2013)

6. The theoretical maximum number of ATP molecules produced from aerobic oxidation of glucose by eukaryotic cells is

- (a) 38
- (b) 24
- (c) 12
- (d) 8

(GATE XL 2013)

7. Which one of the following DO NOT use water as an electron source during photosynthesis?

- (a) Sulfate reducing bacteria
- (b) Methanogenic bacteria
- (c) Green and purple bacteria
- (d) Nitrifying bacteria

(GATE XL 2013)

8. If the radius of a spherical coccus is  $0.8\mu\text{m}$ , the value of surface area to volume ratio in  $\mu\text{m}^{-1}$  will be

- (a) 7.45
- (b) 4.05
- (c) 3.75
- (d) 0.85

(GATE XL 2013)

9. The enzyme that catalyzes the reduction of nitrogen to ammonia is

- (a) nitrogenase
- (b) nitrate reductase
- (c) nitrite reductase
- (d) deaminase

(GATE XL 2013)

10. Chemostat is a continuous culture system in which sterile medium is fed into the culture vessel at the same rate as the spent medium is removed. If in a chemostat culture, the flow rate is  $30 \text{ ml h}^{-1}$  and volume of the medium inside the vessel is 100 ml, the dilution rate in  $\text{h}^{-1}$  is

- (a) 3.33
- (b) 1.50
- (c) 0.75
- (d) 0.30

(GATE XL 2013)

**Q. 11 – Q. 20 carry two marks each.**

1. In an experiment the structural genes *lacZYA* of lac operon were found to be constitutively expressed. The following explanations were given: (P) absence of a functional repressor due to mutation in the repressor gene *lacI* (Q) mutation in the operator that can no longer bind the repressor (R) mutation in the *lacA* gene Which of the following is CORRECT?

- (a) Only P



- (b) Only Q
- (c) Both P & Q
- (d) Only R

(GATE XL 2013)

2. Which one of the following is TRUE about siderophores in bacteria?

- (a) Secreted only when soluble iron is available
- (b) Form complex with ferrous ions in medium
- (c) Are the only route of iron uptake
- (d) Form complex with ferric ions in medium

(GATE XL 2013)

3. In a population containing fast and slow growing bacteria, the slow growing bacteria can be enriched by supplementing the medium with

- (a) chloramphenicol
- (b) penicillin
- (c) penicillin & chloramphenicol
- (d) rifampin

(GATE XL 2013)

4. When the supply of tryptophan is plentiful, the tryptophan operon is repressed because

- (a) repressor protein-corepressor complex is bound at operator
- (b) repressor protein is synthesized in large quantity
- (c) repressor-corepressor complex is not formed
- (d) repressor becomes inactive and reduces operator binding

(GATE XL 2013)

**Group I**

P. Robert Hooke

Q. Paul Ehrlich

R. Antony van Leeuwenhoek

S. Sergei Winogradsky

5. Match the scientists in Group I with their contributions in Group II:

- (a) P-I, Q-II, R-III, S-V
- (b) P-II, Q-IV, R-III, S-V
- (c) P-II, Q-I, R-III, S-IV
- (d) P-V, Q-III, R-IV, S-II

(GATE XL 2013)

6. Match the infectious agents in Group I with associated diseases in Group II:

**Group I**

P. *Bordetella pertussis*

Q. *Mycobacterium leprae*

R. *Haemophilus influenzae*

S. Rubella

**Group II**

I. Mumps

II. Meningitis

III. Tuberculosis

IV. Whooping cough

V. Hansen's disease

- (a) P-IV, Q-V, R-II, S-I
- (b) P-V, Q-III, R-I, S-IV
- (c) P-I, Q-III, R-V, S-IV
- (d) P-III, Q-II, R-V, S-I

(GATE XL 2013)

7. Match the microscopes in Group I with their working principles in Group II:

**Group I**

P. Phase contrast

Q. Dark field

R. Bright field

S. Electron microscopy

**Group II**

I. Light from sides only

II. Uses fluorescent dyes

III. RI difference from medium

IV. Contrast difference from background

V. Uses electrons instead of photons

- (a) P-V, Q-II, R-III, S-V

- (b) P-III, Q-I, R-IV, S-V
- (c) P-III, Q-II, R-V, S-I
- (d) P-II, Q-I, R-III, S-V

(GATE XL 2013)

8. In a phenol coefficient test for disinfectant X, effective dilution for X and phenol were 1/450 and 1/90. Calculate the phenol coefficient.

- (a) 10.0
- (b) 5.0
- (c) 1.0
- (d) 0.2

(GATE XL 2013)

9. How many electrons are accepted when sulfate acts as the terminal electron acceptor in *Desulfovibrio*?

- (a) 8
- (b) 6
- (c) 4
- (d) 2

(GATE XL 2013)

10. A bacterial population increases from  $10^3$  cells to  $10^9$  cells in 10 hours. Calculate the number of generations per hour.

- (a) 20
- (b) 10
- (c) 4
- (d) 2

(GATE XL 2013)

## Section L: Zoology

**Q. 1 – Q. 10 carry one mark each.**

**Q.1** Which one of the following provides the strongest support for the theory of “descent with modification”? (GATE XL 2013)

1. Early embryonic forms of diverse organisms (examples: fishes, birds and mammals) appear similar
2. Ability of fishes and whales to swim
3. Variation in flower colour in a given species
4. Skin colour variation among individuals in a human population

**Q.2** Which one of the following is an example of sympatric speciation? (GATE XL 2013)

1. Origin of new species among wasps that pollinate figs
2. Emergence of a new species among finches that migrated to an island and thus isolated from their ancestors
3. Evolution of birds' and bats' wings
4. Speciation of squirrels separated by a wide river

**Q.3** The primary difference between glycogen and cellulose is in the (GATE XL 2013)

1. types of constituent monosaccharides
2. number of monomers per molecule
3. configuration of the monomers
4. susceptibility to acid hydrolysis

**Q.4** Control mechanisms operate at any of the several steps involved in gene expression. Which one of the following is the key mode of regulation during the cell cycle? (GATE XL 2013)

1. Transcription
2. mRNA processing

3. Activation of protein function resulting from protein-protein interaction
4. mRNA export

**Q.5** Testicular feminization syndrome is a genetic condition wherein an individual with a XY genotype will have an external female-like phenotype. This is caused by (GATE XL 2013)

1. Functional loss of androgen receptor
2. Increased production of estrogen and its receptor
3. Functional loss of Mullerian inhibiting hormone
4. Functional loss of androgen receptor and Mullerian inhibiting hormone

**Q.6** Which one of the following defects do you expect to see if you were able to specifically block apoptosis in the developing limb bud of a frog embryo? (GATE XL 2013)

1. The digits will remain connected through a web-like extension
2. The bones will not form, and the limb would look like a paddle
3. The limb would look normal but would be larger in size
4. The anterior-posterior polarity of the limb will be lost

**Q.7** The formation of antigen-antibody complex helps in disposing antigen through the following pathways EXCEPT: (GATE XL 2013)

1. Neutralizing the antigen by blocking its activity
2. By directly hydrolyzing the antigen
3. By promoting the precipitation of antigen
4. By activating cell lysis pathway

**Q.8** The term “ecological succession” refers to: (GATE XL 2013)

1. A process wherein newer species populate a region that was devoid of flora and fauna

2. A transition phase wherein one particular set of species is replaced by another set of species
3. Changes in the community due to a disturbance in the habitat
4. All the above

**Q.9** Which one of the following options provide example for the term “habitu-  
uation” in behavioral ecology? (GATE XL 2013)

1. A fish transferred to a fish tank startles initially for a hand clap, but not later
2. Migratory birds from the temperate zone migrating towards the tropical part during the winters
3. Adult kingfisher birds are more successful in catching fishes than their younger siblings
4. Female lizard getting used to a new male lizard during the courtship period

**Q.10** Among the following cell structure-function pairs, identify the correctly  
paired one (GATE XL 2013)

1. Microvilli – engulfment of foreign bodies
2. Cytoskeleton – cell migration
3. Peroxisomes – cellular respiration
4. Nucleolus – mRNA transcription

**Q. 11 – Q. 20 carry two marks each.**

**Q.11** Which of the following most accurately states the goal of systematics?  
(GATE XL 2013)

1. Classification scheme should reflect phylogenetic relationship
2. All animals should be classified based on the relatedness at the early embryonic stage
3. All animals should be grouped based on DNA sequence data
4. Classification of animals should be based on morphological characters

**Q.12** Among the following options, choose the one that is probably a cause of rapid diversification of animal groups during the Cambrian explosion. (GATE XL 2013)

1. Adaptation of organisms to live in the salty environment of ocean
2. Emergence of coelom
3. The movement of animals to land
4. The accumulation of sufficient atmospheric oxygen to support the metabolism of actively moving animals

**Q.13** A newly discovered, recessively-inherited disease-susceptibility trait (*D*) is observed only in cotton plants with white flowers, although the flower colour (*R*) and DS are independently inherited. In a breeding programme, one variety that is homozygous for the absence of DS, but heterozygous for *R* was mated to another having white flowers but heterozygous for DS. What is the probability that a given plant among the cross progeny will be susceptible to the disease? (GATE XL 2013)

1. 25%
2. 12.5%
3. 75%
4. 0%

**Q.14** In a new species of moth, the genes for body colour (*B/b*), wing size (*W/w*), and eye colour (*R/r*) are linked. Recombination frequencies: B-W: 5%, R-W: 15%, B-R: 10%. Which among the following is the correct order of these three genetic loci? (GATE XL 2013)

1. Body colour – Eye colour – Wing size
2. Eye colour – Wing size – Body colour
3. Wing size – Body colour – Eye colour
4. Eye colour – Body colour – Wing size

**Q.15** From the options given below, identify the correct combination that truly represents the adaptation seen in desert mammals: (GATE XL 2013)

1. Options i and iii
2. Options ii and iii
3. Options i and iv
4. Options i and v

**Q.16** In *Drosophila*, mutations in homeotic genes result in which one of the following developmental defects? (GATE XL 2013)

1. The anterior portion of the embryo will not develop
2. Several segments in the anterior region of the embryo will be lost
3. Segmentation will be lost, and the embryo will have only one segment
4. Segment-specific identities will be lost

**Q.17** Retroviruses escape pre-existing antibodies in the host by: (GATE XL 2013)

1. Editing the surface antigen post-translationally
2. RNA polymerase of these viruses having high mutation rate
3. Surface antigens are attacked by host proteases
4. Host DNA polymerase mutates the viral genome

**Q.18** Match the following age structure patterns with their implications: (GATE XL 2013)

1. I–ii; II–iii; III–iv; IV–i
2. I–ii; II–iii; III–ii; IV–iv
3. I–i; II–ii; III–iii; IV–iv
4. I–i; II–iii; III–ii; IV–iv

**Q.19** Which one of the following examples is NOT true with regard to the evolution of behavior by natural selection? (GATE XL 2013)

1. The behavioral trait is determined only by genes
2. The behavioral trait varies within the population of that species



3. The reproductive success partly depends on the behavioral trait
4. The behavioral trait is influenced by the genotype

**Q.20** Among the following molecular process–biological effect pairs, identify the mismatched pair. (GATE XL 2013)

1. Histone deacetylation – activation of gene expression
2. Protein phosphorylation – signal transduction
3. DNA methylation – sex-specific control of gene expression
4. Proteolytic cleavage – activation of signaling by peptide hormones

## Section M: Food Technology

**Q. 1 – Q. 10 carry one mark each.**

**Q.1** Kawashiorkor disease is caused due to the deficiency of (GATE XL 2013)

1. lysine
2. unsaturated fatty acids
3. vitamin K
4. protein

**Q.2** Which of the following statements is TRUE in case of oxidative rancidity of vegetable oils and fats? (GATE XL 2013)

1. It is caused by the reaction of saturated fatty acids and oxygen
2. It involves polymerization of fatty acids
3. It is caused by the reaction of unsaturated fatty acids with oxygen
4. It is caused by oxidative enzymes

**Q.3** The food borne disease, Q fever is caused by the organism (GATE XL 2013)

1. *Clostridium perfringens*
2. *Coxiella burnetii*
3. *Bacillus cereus*
4. *Staphylococcus aureus*

**Q.4** The primary bacterial spoilage of poultry meat at low temperature, with characteristic sliminess at outer surface, is caused by (GATE XL 2013)

1. *Pseudomonas spp.*
2. *Aspergillus spp.*
3. *Bacillus spp.*

4. *Candida spp.*

**Q.5** The weight gain (*in gram*) per gram protein consumed is called (GATE XL 2013)

1. Net Protein Ratio (NPR)
2. Biological Value (BV)
3. Protein Efficiency Ratio (PER)
4. Chemical Score (CS)

**Q.6** Which of the following carbohydrates is NOT classified as dietary fibre?  
(GATE XL 2013)

1. Agar
2. Pectin
3. Sodium alginate
4. Tapioca starch

**Q.7** In the extruder barrel, the compression is achieved by back pressure created by the die and by (GATE XL 2013)

1. increasing pitch and decreasing diameter of the screw
2. using the tapered barrel with constant pitch
3. increase in the clearance between barrel surface and screw
4. opening of the die

**Q.8** The brown colour of bread crust during baking is due to Maillard reaction between (GATE XL 2013)

1. aldehyde groups of sugars and amino groups of proteins
2. aldehyde groups of sugars and vitamins
3. aldehyde groups of sugars and salt
4. starch and yeast

**Q.9** Blanching influences vegetable tissues in terms of (GATE XL 2013)

1. enzymes production
2. alteration of cytoplasmic membrane
3. stabilization of cytoplasmic proteins
4. stabilization of nuclear proteins

**Q.10** When garlic is cut or processed, the crushed garlic odour is due to the formation of (GATE XL 2013)

1. diacetyl
2. diallyl disulfide
3. ethyl butyrate
4. benzaldehyde

**Q. 11 – Q. 20 carry two marks each.**

**Q.11** Match the toxicants of plant foods in Group I with their main plant source in Group II. (GATE XL 2013)

1. P-2, Q-3, R-4, S-1
2. P-2, Q-4, R-3, S-1
3. P-3, Q-1, R-2, S-4
4. P-4, Q-3, R-1, S-2

**Q.12** Match the products in Group I with the enzymes used in Group II. (GATE XL 2013)

1. P-2, Q-1, R-4, S-3
2. P-3, Q-1, R-2, S-5
3. P-1, Q-3, R-2, S-4
4. P-1, Q-2, R-4, S-5

**Q.13** Match the food items in Group I with the type of colloidal dispersion in Group II. (GATE XL 2013)

1. P-4, Q-1, R-2, S-3
2. P-3, Q-1, R-2, S-5
3. P-2, Q-3, R-4, S-5
4. P-2, Q-1, R-4, S-3

**Q.14 Assertion [A]:** In the presence of sucrose, the temperature and time for gelatinization of starch increases.

**Reason [R]:** Sucrose, due to its hygroscopic nature, competes with starch for water needed for gelatinization. (GATE XL 2013)

1. Both [A] and [R] are true and [R] is the correct reason for [A]
2. Both [A] and [R] are true but [R] is not the correct reason for [A]
3. Both [A] and [R] are false
- A is true but [R] is false

**Q.15** Thermal death of viable spores of *Bacillus subtilis* in a food sample follows first-order kinetics with a specific death rate constant of  $0.23 \text{ min}^{-1}$  at  $100^\circ\text{C}$ . The time (*in minutes*) required to kill 99% of spores at  $100^\circ\text{C}$  will be (GATE XL 2013)

1. 10
2. 20
3. 23
4. 60

**Q.16** How much skim milk (*in kg*) containing 0.1% fat should be added to 500 kg of cream containing 50% fat to produce standardized cream containing 36% fat? (GATE XL 2013)

1. 140
2. 165

3. 195

4. 210

**Q.17** Which of the following statements is NOT CORRECT in relation to muscle proteins? (GATE XL 2013)

1. Actin and myosin interact to form actomyosin responsible for muscle contraction
2. Collagen contributes to toughness of muscles due to its abundant presence
3. Elastin, a constituent of ligaments, is tougher than collagen
4. Actomyosin is not the main state of actin and myosin in post-mortem muscles

**Q.18** A cold storage plant is used for storing 50 tonnes of apples in perforated plastic crates. During the storage, apples are cooled down from  $28^{\circ}\text{C}$  to storage temperature  $2^{\circ}\text{C}$ . (Specific heat of apple =  $0.874 \text{ kcal/kg}^{\circ}\text{C}$ ). If the required cooling is attained in 16 hours, the refrigeration plant capacity (in Tons) is (GATE XL 2013)

1. 19

2. 24

3. 29

4. 32

**Q.19** An actively growing culture of *Acetobacter aceti* is added to vigorously aerated fermented fruit juice medium containing 10 g/L ethanol to produce vinegar. After some time, the ethanol concentration in the medium is 0.8 g/L, acetic acid produced 8.4 g/L. What is the conversion efficiency of the process with respect to theoretical yield? (GATE XL 2013)

1. 30

2. 50

3. 70

4. 90

**Q.20** An enzyme-catalyzed reaction (*Michaelis – Menten*) has  $V_{max} = 75$  nmol/L·min. At substrate concentration  $1 \times 10^{-4}$  M, initial velocity is 60 nmol/L·min. What is the  $K_m$ ? (GATE XL 2013)

1.  $2.5 \times 10^{-5}$

2.  $5.0 \times 10^{-5}$

3.  $2.5 \times 10^{-4}$

4.  $5.0 \times 10^{-4}$