GATE 2017 Question Paper (Life Sciences - XL)

EE25BTECH11019
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General Aptitude (GA)

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

1) If (→) denotes increasing order of intensity, then the meaning of the words (walk → jog → sprint) is analogous to (bothered → _ → daunted). Which one of the given options is appropriate to fill the blank? (GATE XL 2024)

a) phased b) phrased c) fazed d) fused

2) Two wizards try to create a spell using all the four elements - water, air, fire, and earth. They decide to mix all these elements in all possible orders and work independently. After trying all possible combinations, they conclude the spell does not work. How many attempts does each wizard make before coming to this conclusion? (GATE XL 2024)

a) 24 b) 48 c) 16 d) 12

3) In an engineering college of 10,000 students, 1,500 like neither their core branches nor other branches. The number of students who like their core branches is $\frac{1}{4}$th of the number of students who like other branches. The number of students who like both their core and other branches is 500. The number of students who like their core branches is (GATE XL 2024)

a) 1,800 b) 3,500 c) 1,600 d) 1,500

4) For positive non-zero real variables x and y, if

$$\left(x + \frac{1}{y}\right)^2 = \left(y + \frac{1}{x}\right)^2 \tag{1}$$

then the value of $\frac{x}{y}$ is (GATE XL 2024)

a) 1 b) $\frac{1}{2}$ c) 2 d) 4

5) In the sequence $6, 9, 14, x, 30, 41$, a possible value of x is (GATE XL 2024)

a) 25 b) 21 c) 18 d) 20

Q. 6 - Q. 10 CARRY TWO MARK EACH.

6) Sequence the following sentences in a coherent passage: (GATE XL 2024)

a) QPSR b) QSPR c) SPRQ d) SATQ

7) A person sold two different items at the same price. He made (10%) profit in one item, and (10%) loss in the other item. In selling these two items, the person made a total of (GATE XL 2024)

a) (1%) profit b) (2%) profit c) (1%) loss d) (2%) loss

8) The pie charts depict the shares of various power generation technologies in the total electricity generation of a country for the years 2007 and 2023.

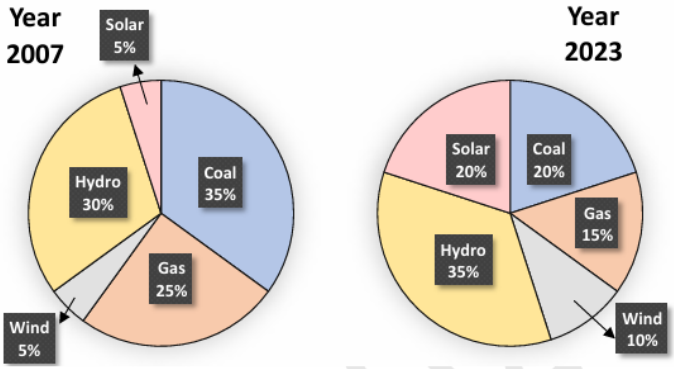


Fig. 1: Q8 que.

The renewable sources of electricity generation consist of Hydro, Solar and Wind. Assuming that the total electricity generated remains the same from 2007 to 2023, what is the percentage increase in the share of the renewable sources of electricity generation over this period? (GATE XL 2024)

a) 25% b) 50% c) 77.5% d) 62.5%

9) A cube is to be cut into 8 pieces of equal size and shape. Each cut should be straight and should not stop till it reaches the other end of the cube. The minimum number of such cuts required is (GATE XL 2024)

a) 3 b) 4 c) 7 d) 8

10) In the 4×4 array shown below, each cell of the first three rows has either a cross (X) or a number.

1	X	4	3
X	5	5	4
3	X	6	X

Fig. 2: Q10 que.

The number in a cell represents the count of the immediate neighboring cells (left, right, top, bottom, diagonals) NOT having a cross (X). Given that the last row has no crosses (X), the sum of the four numbers to be filled in the last row is (GATE XL 2024)

a) 11 b) 10 c) 12 d) 9

General Aptitude (GA)

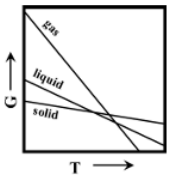
Q. 11 - Q. 19 carry one mark each.

11) The CORRECT order of electronegativity is (GATE XL 2024)

a) Al > Si > P > S
b) Al > S > Si > P
c) S > Si > Al > P
d) S > P > Si > Al

12) Which one of the following is the CORRECT representation of the variation of the Gibbs free energy G of a substance with temperature T at constant pressure? (GATE XL 2024)

a)



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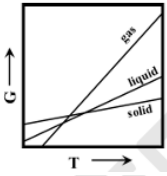

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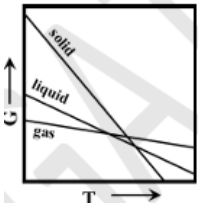

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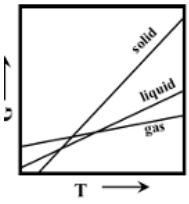
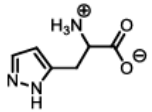


13) Among the following, the structure representing histidine is (GATE XL 2024)

a)



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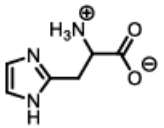

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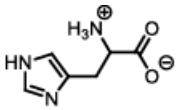
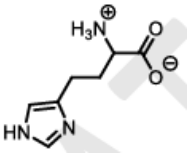


d)



14) The CORRECT order of acidity of the following compounds is: (GATE XL 2024)

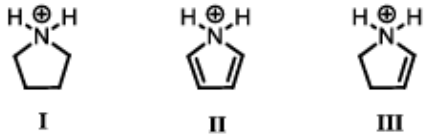


Fig. 3: Q14 que.

a) I > II > III b) II > III > I c) I > III > II d) III > II > I

15) The molecules A and B are a pair of: (GATE XL 2024)

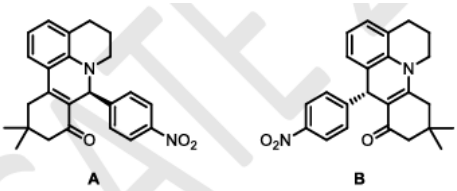


Fig. 4: Q15 que.

a) enantiomers
b) diastereomers
c) conformational isomers
d) constitutional isomers

16) The CORRECT option(s) of Y for the following reaction is/are: (GATE XL 2024)

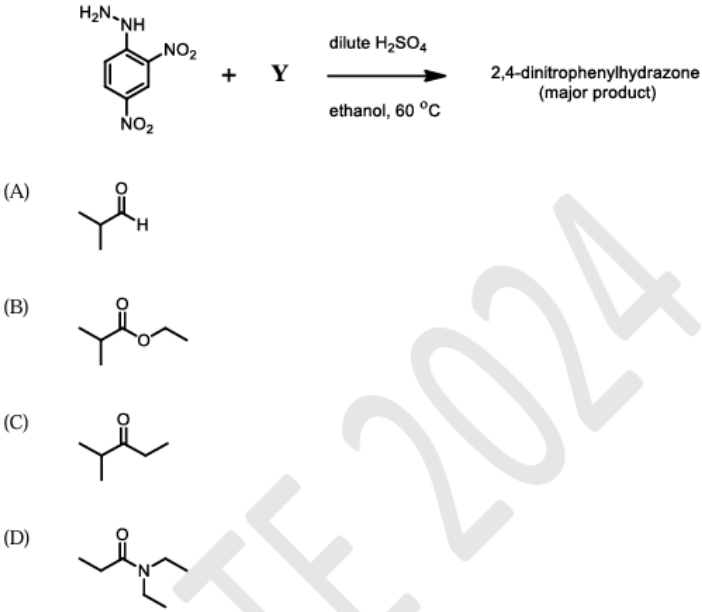


Fig. 5: Q16 que.

17) The maximum number of electrons that can be accommodated in the shell with $n = 2$ is (in integer). (Given: n = principal quantum number) (GATE XL 2024)
18) One mole of an ideal gas expands isothermally and reversibly to double its volume. If the expansion work done by the system is 1728.85 J, the temperature of the system is K (rounded off to 2 decimal places). (Given: Gas constant, $R = 8.314$ J K^{-1} mol^{-1}) (GATE XL 2024)
19) The initial rate of a reaction triples when the concentration of a reactant, A, is doubled. The order of the reaction with respect to A is (rounded off to 2 decimal places). (GATE XL 2024)

Q. 20 - Q. 27 CARRY TWO MARK EACH.

20) Each of the following alkenes undergoes addition reaction with bromine. Under the same reaction conditions, the CORRECT trend in the reaction rates is: (GATE XL 2024)

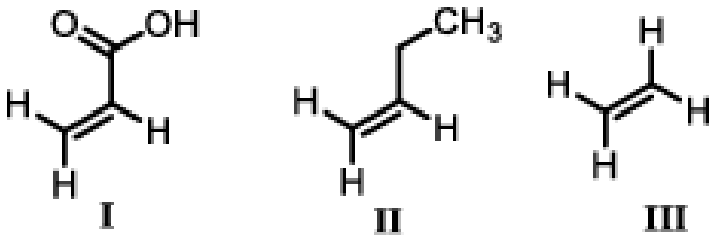


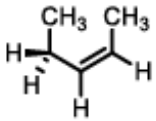
Fig. 6: Q20 que.

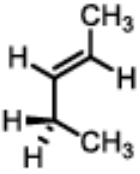
a) I > II > III b) II > III > I c) I > III > II d) III > II > I

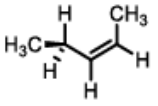
21) An enzyme-catalyzed conversion of a substrate at 298 K proceeds by a Michaelis-Menten mechanism. The Lineweaver-Burk plot for the analysis of the experimental data has an intercept along the *y*-axis of 0.357 $mmol^{-1}$ dm^3 s and a slope of 2.10 s. The CORRECT Michaelis constant for the reaction is (rounded off to 2 decimal places). (GATE XL 2024)

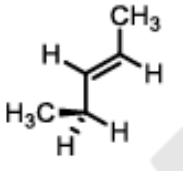
a) 5.88 mmol dm^{-3}
b) 5.88 mmol dm^{-3} s^{-1}
c) 2.80 mmol dm^{-3}
d) 2.80 mmol dm^{-3} s^{-1}

22) Which one among the following structures is the most stable conformer of (*Z*)-pent-2-ene? (GATE XL 2024)

a)


b)


c)


d) 

23) Upon addition of compound X to an aqueous $AgNO_3$ solution, a white precipitate appears instantly. Also, X does not exhibit geometrical isomerism. The CORRECT option(s) for X is/are: (GATE XL 2024)

a) $([Cr(OH_2)_4Cl_2]Cl)$
b) $([Cr(OH_2)_5Cl]Cl_2)$
c) $([Cr(OH_2)_6]Cl_3)$
d) $([Cr(OH_2)_3Cl_3])$

24) The paramagnetic species among the following is/are (Given: Atomic numbers of Cr = 24; Fe = 26; Ni = 28) (GATE XL 2024)

a) $\left([Fe(CN)_6]^{3-}\right)$
b) $\left([Ni(OH_2)_6]^{2+}\right)$
c) $\left([Fe(CN)_6]^{4-}\right)$
d) $\left([Cr(CN)_6]^{3-}\right)$

25) The molecule(s) with non-zero dipole moment is/are: (GATE XL 2024)

a) N_2 b) CO_2 c) NO d) SO_2

26) The ionic product of water at 40 °C is 2.92×10^{-14} M^2. The pH of water at 40 °C is (GATE XL 2024)

27) Given the standard reduction potentials E° for the half-cell reactions below, the standard Gibbs free energy of the dissolution of silver chloride in water, at 298 K, is J mol^{-1} (rounded off to nearest integer). (Given: Faraday constant, F = 96500 C mol^{-1}; $J = C \times V$)

$$AgCl(s) + e^- \rightarrow Ag(s) + Cl^-(aq); \quad E^\circ = 0.22\,V \tag{2}$$

$$Ag^+(aq) + e^- \rightarrow Ag(s); \quad E^\circ = 0.80\,V \tag{3}$$

(GATE XL 2024)

Biochemistry (XL-Q)

Q.28 - Q.35 Carry ONE mark Each

28) Which one of the following pairs of amino acids is NOT incorporated in a polypeptide chain? (GATE XL 2024)

a) 4-Hydroxyproline and γ-carboxyglutamate
b) γ-Carboxyglutamate and desmosine
c) Ornithine and citrulline
d) 4-Hydroxyproline and 5-hydroxylysine

29) Mammalian cells cultured at low temperature (25 to 30 °C) lead to an increased sterol content in the membrane. Elevated sterols in the membrane result in: (GATE XL 2024)

a) an increase in membrane fluidity
b) a decrease in membrane permeability to water
c) an increase in membrane permeability to water
d) a decrease in membrane fluidity

30) Which one of the following metabolic intermediates is common to glycolysis, nucleotide synthesis and glycogen synthesis? (GATE XL 2024)

a) Citrate
b) Oxaloacetate
c) Glucose 6-phosphate
d) Glycerol 3-phosphate

31) Cells that can give rise to all types of cells in the body are known as(GATE XL 2024)

a) totipotent stem cells
b) pluripotent stem cells
c) multipotent stem cells
d) lymphoid progenitor cells

32) Which one or more of the following statements correctly describe(s) the addition of N-nucleotides during the rearrangement of the immunoglobulin heavy chain-encoding gene? (GATE XL 2024)

a) Addition of N-nucleotides is template encoded.
b) N-nucleotides are added by terminal deoxynucleotidyl transferase.
c) The added N-nucleotides are common in V-D and D-J junction.
d) N-nucleotides are added by the DNA polymerase II.

33) A newly identified viral protein contains one long α-helix spanning 60 amino acid residues. The number of main chain H-bonds formed in this helix is (Answer in integer). (GATE XL 2024)

34) In a lactic acid solution at pH 4.8, the concentrations of lactic acid and lactate are 0.01 M and 0.087 M, respectively. The calculated pKa of lactic acid is (Round off to one decimal place). (GATE XL 2024)

35) If a 10 mM solution of a biomolecule in a cuvette of path length 10 mm absorbs 90% of the incident light at 280 nm, the molar extinction coefficient of the biomolecule at this wavelength is $M^{-1}cm^{-1}$. (Round off to two decimal places)(GATE XL 2024)

Q.36 - Q.46 Carry TWO mark Each

36) Metabolic intermediates provide the backbone for the synthesis of amino acids. Match the metabolic intermediates listed in Column I with their corresponding amino acids given in Column II. (GATE XL 2024)

Group I	**Group II**
P) α-Ketoglutarate	1) Histidine
Q) Ribose 5-phosphate	2) Glutamate
R) 3-Phosphoglycerate	3) Aspartate
S) Phosphoenolpyruvate	4) Phenylalanine

37) Which one of the following is the correct match between the molecular properties listed in Column I and the corresponding biochemical separation methods in Column II? (GATE XL 2024)

Column I	**Column II**
P) Solubility	1) Reverse phase chromatography
Q) Ionic charge	2) Ultracentrifugation
R) Polarity	3) Salting out
S) Molecular size	4) Gel filtration

38) Which one or more of the following statements is/are correct regarding the electromotive force generated by electron transfer chain? (GATE XL 2024)

a) It is used for the synthesis of ATP.
b) It is not used for active transport process.
c) It includes a pH gradient component.
d) It does not include an electrical potential gradient component.

39) Which one or more of the following statements is/are correct regarding the transport and retention of proteins in different cell organelles? (GATE XL 2024)

a) Mannose 6-phosphate residues are involved in targeting proteins to lysosomes.
b) Transport of proteins into the mitochondrial compartment is aided by positively charged amino acid residues at the N-terminus and internal hydrophobic segments.
c) The retention of protein in the ER lumen requires the KDEL sequence motif at the C-terminus.
d) Nuclear proteins are transported in an unfolded conformation and the nuclear localization signal sequence is subsequently cleaved by peptidases in the nucleoplasm.

40) Which one or more of the following statements correctly describe(s) fluorescence spectroscopy? (GATE XL 2024)

a) The emission maxima is independent of the excitation wavelength.
b) The emission maxima depends on the concentration of a quencher.
c) The emission maxima varies with solvent polarity.
d) The emission maxima varies with temperature.

41) Which one or more of the following statements is/are correct in the processing of pre-mRNA in eukaryotes? (GATE XL 2024)

a) $3' \rightarrow 5'$ exonuclease activity is involved in the conversion of pre-mRNA to mRNA.
b) $5'$-capping and addition of $3'$-poly A tail precedes splicing.
c) Splicing of pre-mRNA occurs via transesterification reaction.
d) Alternative splicing can yield different mRNA products from the same pre-mRNA.

42) Which one or more of the following statements correctly describe(s) the changes upon the addition of puromycin during eukaryotic translation? (GATE XL 2024)

a) Puromycin resembles aminoacyl end of the charged tRNA.
b) Puromycin occupies the A site of the translating ribosomes.
c) Puromycin occupies the P site of the translating ribosomes.

d) Puromycin occupies the E site of the translating ribosomes.

43) Factor H, a complement regulatory protein in plasma, binds C3b and (GATE XL 2024)
   a) competes with factor B to displace Bb from convertase.
   b) initiates the catabolism of C3b into inactivate products.
   c) then binds to C3bBb convertase.
   d) acts as a cofactor for factor I.

44) The value of V_{max} is (Round off to three decimal places) (GATE XL 2024)

45) A 5250 base-pair long plasmid with 10 negative supercoils would have a linking number of (Answer in integer). (Considering 10.5 base pairs per turn for B-DNA) (GATE XL 2024)

46) The spectrum of a protein obtained using electrospray ionization mass spectrometry (ESI-MS) is shown below. Two peaks, one at m/z = 2960.6 and the other at m/z = 3552.5, are marked. The mass of the protein associated with the m/z = 2960.6 peak is Da. (Round off to two decimal places)

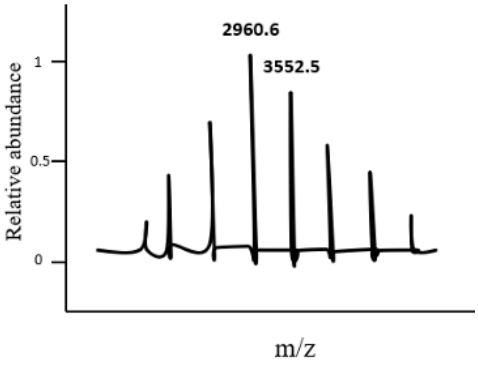


Fig. 7: Q46 que.

(GATE XL 2024)

Botany (XL-R)

Q. 47 - Q. 54 carry one mark each.

47) Which one or more of the following statements is/are correct regarding the structure and function of immunoglobulin? (GATE XL 2024)
   a) The variable region of the heavy chain determines the class of immunoglobulin.
   b) The constant region of the heavy chain determines the class of immunoglobulin.
   c) The antigen binding site is formed by the variable regions of both heavy and light chains.
   d) The Fc region is responsible for antigen binding.

48) Which one or more of the following statements is/are correct regarding the role of chaperones in protein folding? (GATE XL 2024)

a) Chaperones prevent aggregation of unfolded proteins.
b) Chaperones catalyze the formation of disulfide bonds.
c) Chaperones assist in refolding of misfolded proteins.
d) Chaperones are required for folding of all cytosolic proteins.

49) Which one or more of the following statements is/are correct regarding the function of peroxisomes? (GATE XL 2024)

a) Peroxisomes are involved in β-oxidation of very long chain fatty acids.
b) Peroxisomes are involved in the synthesis of bile acids.
c) Peroxisomes are involved in the detoxification of hydrogen peroxide.
d) Peroxisomes are involved in the synthesis of cholesterol.

50) Which one or more of the following statements is/are correct regarding the function of lysosomes? (GATE XL 2024)

a) Lysosomes are involved in degradation of cellular waste.
b) Lysosomes maintain acidic pH using proton pumps.
c) Lysosomes are involved in synthesis of proteins.
d) Lysosomes are involved in autophagy.

51) Which of the following plant diseases is/are caused by nematode?(GATE XL 2024)

a) Cereal cyst of barley
b) Ergot of rye
c) Wart of potato
d) Ear-cockle of wheat

52) Which of the following selectable marker genes is/are used for herbicide tolerance during genetic transformation of plants? (GATE XL 2024)

a) hpt b) bar c) nptII d) pmi

53) Which of the following statements is/are CORRECT with reference to rubber production from plants? (GATE XL 2024)

a) Para rubber is produced from Hevea brasiliensis.
b) India rubber is produced from Ficus elastica.
c) Panama rubber is produced from Manihot glaziovii.
d) Ceara rubber is produced from Castilla elastica.

Q. 55 - Q. 65 CARRY TWO MARK EACH.

54) In Calvin-Benson cycle, to produce 1 molecule of glyceraldehyde 3-phosphate by fixing 3 molecules of carbon dioxide, 9 molecules of ATP and molecules (in integer) of NADPH are typically utilized. (GATE XL 2024)

55) In wild-type Arabidopsis thaliana, the four types of floral organs (sepal, petal, stamen, carpel) are arranged in concentric whorls from outside to inside. With reference to the ABC model of floral organ patterning, match the homeotic mutants in Group I with their respective arrangements of organs in the four whorls given in Group II. (GATE XL 2024)

Group I	**Group II**
P) A class mutants	1) sepal, sepal, carpel, carpel
Q) B class mutants	2) sepal, petal, petal, sepal
R) C class mutants	3) carpel, stamen, stamen, carpel

56) Match the inhibitors in Group I with their respective targets in Group II. (GATE XL 2024)

Group I	**Group II**
P) Oligomycin	1) Cytochrome bc_1 complex
Q) Antimycin A	2) Photosystem II
R) DCMU	3) K^+ ionophore
S) Valinomycin	4) F_0 ATP synthase

57) With reference to Agrobacterium tumefaciens-mediated plant transformation, match the virulence factors in Group I with their protein types in Group II.(GATE XL 2024)

Group I	**Group II**
P) VirG	1) Kinase
Q) VirA	2) Helicase
R) VirE	3) Transcriptional activator
S) VirC	4) -

58) Match the plant products in Group I with the plant species in Group II that produce them and the respective plant parts in Group III where they accumulate the most. (GATE XL 2024)

Group I	**Group II**	**Group III**
P) Liquorice	1) Cinchona calisaya	a) Leaf
Q) Quinine	2) Lawsonia inermis	b) Root
R) Henna	3) Glycyrrhiza glabra	c) Flower
S) Saffron	4) Crocus sativus	d) Bark
		e) Seed

59) Match the types of ecological interactions in Group I with their respective definitions in Group II. (GATE XL 2024)

Group I
P) Protocooperation
Q) Commensalism
R) Amensalism
S) Helotism

Group II

1) One species is harmed but the other is neither harmed nor benefitted
2) A type of mutualism where one species is benefitted more than the other
3) Both species are benefitted but the interaction is not obligatory
4) One species is benefitted without harming the other

60) Match the types of ecological energy productivity in Group I with their respective definitions in Group II. (GATE XL 2024)

Group I

P) Net primary productivity
Q) Gross primary productivity
R) Net productivity
S) Secondary productivity

Group II

1) Total amount of energy produced by autotrophs
2) Amount of energy stored by autotrophs after respiration
3) Net gain of energy by the consumers after energy loss
4) Unused amount of energy after -

61) Which of the following combinations of plant diseases and the types of their causal organisms is/are CORRECT? (GATE XL 2024)

a) Late blight of potato - Bacteria
b) Black rot of crucifer - Bacteria
c) Tungro disease of rice - Mycoplasma
d) Root knot of tomato - Nematode

62) Identify the CORRECT combination(s) of plant natural products and the categories they belong to. (GATE XL 2024)

a) Dhurrin - Phenolic compounds
b) Farnesene - Terpenoids
c) Naringenin - Cyanogenic glycosides
d) Vincristine - Alkaloids

63) Identify the CORRECT combination(s) between the enzymes in Group I and the reactions in Group II they catalyze. (GATE XL 2024)

Group I

P) Cinnamate-4-hydroxylase
Q) Glycerate kinase
R) PEP carboxylase
S) Nitrate reductase

Group II

1) L-phenylalanine $\rightarrow$ Cinnamic acid
2) Glyceraldehyde 3-phosphate $\rightarrow$ dihydroxyacetone phosphate
3) Glycolate + $O_2 \rightarrow$ Glyoxylate + H_2O_2
4) $NO_3^- + NAD(P)H + H^+ \rightarrow NO_2^- + NAD(P)^+ + H_2O$

64) In a genetic cross between two pure-line parents differing in the two independently segregating traits, plant height (tall vs dwarf) and flower color (purple vs white), all

the F_1 plants were tall with purple flowers. In a testcross population involving these F_1 individuals, the expected percentage (%) of dwarf plants with purple flower would be (in integer). (GATE XL 2024)

65) The mRNA of a hypothetical plant gene HSDU is 800-nucleotide long and encodes a protein of 160 amino acid residues. The calculated length of HSDU CDS would be nucleotides (in integer). (GATE XL 2024)

Botany (XL-R)

Q. 66 - Q. 73 carry one mark each.

66) Which one of the following bacterial species can cause atypical pneumonia? (GATE XL 2024)

a) Chlamydia pneumoniae
b) Streptococcus pneumoniae
c) Klebsiella pneumoniae
d) Haemophilus influenzae

67) Which one of the following organisms has axial filaments? (GATE XL 2024)

a) Mycobacterium tuberculosis
b) Pasteurella multocida
c) Treponema pallidum
d) Shigella dysenteriae

68) Who among the following scientists was the pioneer in development of chemotherapy? (GATE XL 2024)

a) Elie Metchnikoff b) Robert Koch c) Paul Ehrlich d) Ronald Ross

69) In which of the following processes is glutaraldehyde used as a sterilizing agent? (GATE XL 2024)

a) Pasteurization b) Incineration c) Cold sterilization d) Autoclaving

70) The most abundant class of immunoglobulins in serum is (GATE XL 2024)

a) IgM b) IgA c) IgD d) IgG

71) Which one of the following double-stranded sequences will NOT be recognized by a Type IIP restriction endonuclease? (GATE XL 2024)

a) 5' – GGTACC – 3' 3' – CCTAGG – 5'
b) 5' – GGATCC – 3' 3' – CCTAGG – 5'
c) 5' – CATATG – 3' 3' – GTATAC – 5'
d) 5' – GATTTC – 3' 3' – CTAAAG – 5'

72) Which one of the following uses inorganic compounds as an energy source? (GATE XL 2024)

a) Heterotrophs
b) Chemolithotrophs
c) Chemoorganotrophs
d) Photoheterotrophs

73) Which one of the following represents the abundance of the organisms found in soil? (GATE XL 2024)
a) Fungi > Aerobic bacteria > Anaerobic bacteria
b) Aerobic bacteria > Fungi > Anaerobic bacteria
c) Anaerobic bacteria > Aerobic bacteria > Fungi
d) Aerobic bacteria > Anaerobic bacteria > Fungi

Q.74 - Q. 84 CARRY TWO MARK EACH.

74) Match the antibiotics in Group I with the microorganisms that produce them in Group II. (GATE XL 2024)

Group I	**Group II**
P) Streptomycin	1) Streptomyces griseus
Q) Bacitracin	2) Bacillus licheniformis
R) Amphotericin B	3) Streptomyces venezuelae
S) Chloramphenicol	4) Streptomyces nodosus

75) Which one of the following redox couples has the highest tendency to donate electrons? (GATE XL 2024)

a) Fumarate / succinate
b) NAD^+/NADH
c) FAD/FADH
d) Pyruvate/lactate

76) Which of the following is/are active transport mechanism(s) in prokaryotes where the substance is chemically altered during transport across the membrane? (GATE XL 2024)

a) Group translocation
b) Simple diffusion
c) Facilitated diffusion
d) Osmosis

77) Which of the following cocci is/are examples of division in one plane? (GATE XL 2024)

a) Staphylococci b) Streptococci c) Micrococci d) Diplococci

78) Which of the following event(s) occur(s) during translation in prokaryotes? (GATE XL 2024)
a) tRNA binding to the start codon of mRNA on the 30S subunit of ribosome
b) Anticodon of tRNA binding to the start codon of mRNA on the 50S subunit of ribosome

c) The ribosome continues to move along the mRNA to add new amino acids to the polypeptide
d) The polypeptide is released when the ribosome reaches the stop codon

79) Which of the following is/are consequence(s) of nitrous acid (HNO_2) mediated deamination? (GATE XL 2024)

a) Conversion of cytosine to uracil
b) Conversion of adenine to hypoxanthine
c) Conversion of guanine to xanthine
d) Addition of alkyl group to the bases

80) At root nodules, which of the following C_4 organic acid(s) is/are transported across the symbiosome membrane and into bacteroids? (GATE XL 2024)

a) Succinate b) Pyruvate c) Malate d) Fumarate

81) Which of the following is/are TRUE about the Escherichia coli chromosome? (GATE XL 2024)

a) It is typically bound by histones.
b) It is circular in nature.
c) It contains multiple origins of replication.
d) It is linear and segmented.

82) At $t = 0$, the bacterial cell number is 10,000 cells/mL. At $t = 480$ minutes, the cell number increased to 320,000 cells/mL. The mean generation time during this exponential growth period, rounded off to the nearest integer, is minutes. (GATE XL 2024)

83) A landfill sample was analyzed by dilution and plating techniques for viable bacterial count. When one gram of the landfill sample was diluted 1×10^{-4} (w/v), it yielded 400 CFU. The viable bacterial count (in million, rounded off to the nearest integer) in one gram landfill sample is (GATE XL 2024)

84) A fluorescence microscope with an objective lens of numerical aperture (NA) = 1.5 is used with light of wavelength $\lambda = 600$ nanometers. The lateral resolution limit of this microscope, rounded off to the nearest integer, is nanometers.(GATE XL 2024)

Zoology (XL-T)

Q. 85 - Q. 92 carry one mark each.

85) Which one of the following statements about gene expression is INCORRECT? (GATE XL 2024)

a) DNA is transcribed to mRNA.
b) mRNA can be reverse-transcribed to DNA.
c) mRNA can be translated to protein.
d) Protein can be reverse-translated to mRNA.

86) Which one of the following tissues/organs is least likely to experience graft rejection when transplanted from a person to an unrelated person? (GATE XL 2024)

a) Bone marrow b) Cornea c) Heart d) Kidney

87) Codon bias is correlated with the relative frequencies of which one of the following types of RNA? (GATE XL 2024)

a) mRNA b) rRNA c) siRNA d) tRNA

88) CREB1 is a eukaryotic transcription factor. In which one of the following compartments of the cell is CREB1 predominantly localized? (GATE XL 2024)

a) Lysosomes b) Mitochondria c) Nucleus d) Peroxisomes

89) In certain species of salamanders, male-female pairs have multiple mating partners in a breeding season. Which one of the following terminologies accurately describes this mating system? (GATE XL 2024)

a) Monogamy b) Polyandry c) Polygyny d) Polygynandry

90) Which one of the following statements describes the key function of human sweat glands? (GATE XL 2024)

a) They serve as touch sensors.
b) They secrete hormones.
c) They regulate body temperature.
d) They store fat.

91) Urease enzyme catalyzes the conversion of urea into ammonia and carbon dioxide. Which one of the following organisms expresses urease enzyme? (GATE XL 2024)

a) Caenorhabditis elegans
b) Drosophila melanogaster
c) Helicobacter pylori
d) Homo sapiens

92) The human genetic code is triplet in nature with 64 codons made using four nucleotides. If the human genetic code was doublet in nature, the number of codons theoretically possible from four nucleotides is (Answer in integer).(GATE XL 2024)

Q. 93 - Q. 103 CARRY TWO MARK EACH.

93) Which one of the following statements is NOT TRUE of glycosaminoglycans? (GATE XL 2024)
a) Glycosaminoglycans are composed of repeating disaccharide units.
b) Glycosaminoglycans consist of amino sugars that are frequently sulfated.
c) Hyaluronic acid is an example of a glycosaminoglycan.
d) Methionine is the predominant amino acid to which glycosaminoglycan chains are conjugated to form proteoglycans.

94) Which one of the options correctly matches the human tissues/organs with their embryonic germ layers of origin? (GATE XL 2024)

Tissues/organs	**Embryonic germ layers**
P) Liver	I) Ectoderm
Q) Cerebellum	II) Endoderm
R) Femur	III) Mesoderm

95) Consider a large population of a finch species, where both small and big beak sizes are advantageous, and an intermediate beak size is maladaptive. Over a period of 10 years, which one of the following evolutionary processes is most likely to operate on the beak size of this finch population? (GATE XL 2024)

a) Directional selection
b) Disruptive selection
c) Genetic drift
d) Stabilizing selection

96) When the blood glucose level of a healthy person is 100 mg/dL, which one of the following options is most likely to represent the level of glucose in the urine of that person? (GATE XL 2024)

a) < 1 mg/dL b) 10 mg/dL c) 50 mg/dL d) 100 mg/dL

97) Which one of the following rooted tree topologies best describes the primate phylogeny? (GATE XL 2024)

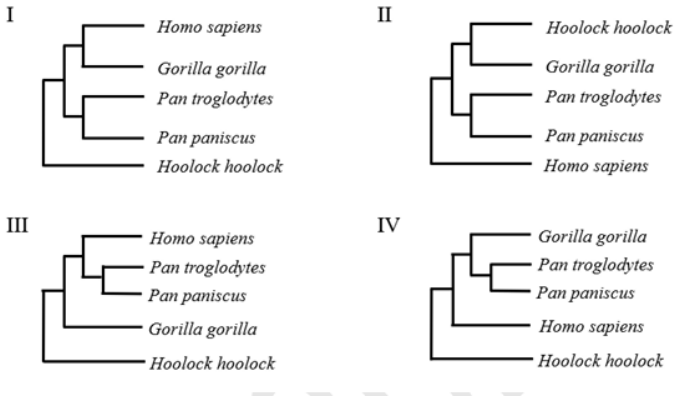


Fig. 8: Q97 que.

a) I b) II c) III d) IV

98) Consider a species of brightly colored beetle. Which one or more of the following observations suggest(s) that this species is aposematic? (GATE XL 2024)

a) Both male and female beetles are brightly colored.
b) Only male beetles are brightly colored.

c) Only female beetles are brightly colored.
d) The beetle species is toxic and distasteful.

99) The embryos of which one or more of the following animals show meroblastic cleavage? (GATE XL 2024)

a) Danio rerio (zebrafish)
b) Gallus gallus (chicken)
c) Synapta digita (sea cucumber)
d) Xenopus laevis (frog)

100) Which one or more of the following parasites is/are typically transmitted by mosquitoes as vector? (GATE XL 2024)

a) Leishmania donovani
b) Plasmodium vivax
c) Wuchereria bancrofti
d) Trichuris trichiura

101) Consider the following nucleotide sequence: 5′-GCCGCCAUGGCGUCUGCUAGCUGGCUCGAUCGCGAGCGAUCGUACGU AUAGUAUGAA-3′ Assume canonical initiation, canonical termination, no post-translational modification, and the average molecular mass of an amino acid to be 110 daltons. The theoretical molecular mass of the polypeptide translated from the above nucleotide sequence is daltons. (Answer in integer) (GATE XL 2024)

102) The pKa of a buffer solution with pH of 5, consisting of 0.4 M sodium acetate and 0.04 M acetic acid, is (Answer in integer). (GATE XL 2024)

103) Consider a healthy person with the following lung volumes: Residual volume = 900 mL Expiratory reserve volume = 800 mL Tidal volume = 200 mL If the total lung capacity is 5500 mL, then the inspiratory reserve volume of the person is mL. (Answer in integer) (GATE XL 2024)

Food Technology (XL-U)

Q. 104 - Q. 111 carry one mark each.

104) Which one of the following fungi produces aflatoxins? (GATE XL 2024)

a) Aspergillus niger
b) Fusarium verticillioides
c) Aspergillus flavus
d) Rhizopus oligosporus

105) Under standard conditions in animal feeding studies, the weight gained (in grams) per gram of protein consumed by an animal is termed as: (GATE XL 2024)

a) Net Protein Ratio
b) Net Protein Utilization
c) Coefficient of Protein Digestibility
d) Protein Efficiency Ratio

106) Xerophthalmia is caused due to the deficiency of: (GATE XL 2024)

a) Thiamin b) Pantothenic acid c) Vitamin A d) Vitamin C

107) Which one of the following steps is used to remove phosphatides from crude oil in the refining process? (GATE XL 2024)

a) Neutralization b) Bleaching c) Degumming d) Deodorization

108) The unique flavor of chocolate and cocoa is due to the formation of:(GATE XL 2024)

a) 5-methyl-2-phenyl-2-hexenal
b) Cyclotene
c) Furaneol
d) Maltol

109) Which one of the following statements regarding Hazard Analysis Critical Control Point (HACCP) plan is NOT correct? (GATE XL 2024)

a) HACCP is a management tool for ensuring food safety.
b) HACCP involves five preliminary steps and seven principles.
c) HACCP is not effective without prior implementation of prerequisite programs.
d) HACCP plan involves establishment of corrective actions as second principle.

110) The product of cabbage fermentation by *Leuconostoc mesenteroides* is: (GATE XL 2024)

a) Tempeh b) Natto c) Sauerkraut d) Miso

111) Which one of the following absorbents is NOT used as an ethylene absorber in active packaging of fruits and vegetables? (GATE XL 2024)

a) Potassium permanganate
b) Activated carbon
c) Calcium hydroxide
d) Silica gel

Q.112 - Q.122 CARRY TWO MARK EACH.

112) Which one of the following statements regarding moisture sorption isotherms of a dried food is NOT correct? (GATE XL 2024)

a) At a given temperature, the difference between adsorption and desorption moisture isotherms is known as hysteresis.
b) At a given temperature and water activity, an adsorption isotherm exhibits higher equilibrium moisture content than a desorption isotherm in hysteresis.
c) At a given moisture content, effect of temperature on a moisture sorption isotherm follows the Clausius-Clapeyron equation.
d) The Guggenheim-Anderson-de Boer (GAB) equation is a multilayer moisture sorption model.

113) Processing of fluid milk at 72 °C for 15 seconds is termed as: (GATE XL 2024)

a) High-temperature, short-time (HTST) pasteurization
b) Low-temperature, long-time (LTLT) pasteurization
c) Ultra high-temperature (UHT) pasteurization

d) Homogenization process

114) Match the anti-nutritional factors in Column I with their corresponding activity given in Column II. (GATE XL 2024)

Column I	**Column II**
P) Lectin	1) Flatulence
Q) Stachyose	2) Chelates with divalent cations and reduces their bioavailability
R) Phytate	3) Inhibits trypsin and chymotrypsin
S) Knuitz type inhibitor	4) Hemagglutination

115) Which of the following fatty acids is/are known to increase the low-density lipoprotein (LDL) levels? (GATE XL 2024)

a) Omega-3 fatty acids
b) Trans fatty acids
c) Conjugated linoleic acids
d) Saturated fatty acids

116) The addition of which of the following to high-methoxyl pectin will result in gel formation? (GATE XL 2024)

a) Calcium ions b) Hydrogen ions c) Sodium ions d) Sugar

117) Which of the following steps in food processing is/are used to reduce acrylamide formation in food products? (GATE XL 2024)

a) Pretreatment using asparaginase
b) Lowering the pH
c) Increasing the temperature
d) Adding glucose

118) Which of the following enzymes is/are used for the production of high fructose syrup (HFS) from corn starch? (GATE XL 2024)

a) α-Amylase b) β-Amylase c) Xylose isomerase d) Glucoamylase

119) Which of the following is/are typical characteristic(s) of a fungal cell? (GATE XL 2024)

a) Presence of histone proteins
b) Presence of peptidoglycans in the cell wall
c) Presence of chitin in the cell wall
d) Presence of pseudomurein in the cell wall

120) Which of the following statements is/are correct regarding food and water borne diseases and the class of causative microorganisms? (GATE XL 2024)

a) Legionellosis is a bacterial disease.
b) Giardiasis is caused by protists.

c) Typhoid fever is caused by virus.
d) Listeriosis is a fungal disease.

121) Which of the following statements is/are true? (GATE XL 2024)

a) Hagen-Poiseuille's law is used for calculation of molecular diffusion.
b) Fick's law is used for calculation of energy requirement in size reduction.
c) Rittinger's law is used for calculation of energy requirement in size reduction.
d) Stokes' law is used for calculation of terminal velocity.

122) A 10 kg tomato pulp is concentrated from an initial moisture content of 90% (wet weight basis) to 35% (wet weight basis). The weight of the concentrate in kg is (round off to 2 decimal places). (GATE XL 2024)