GATE 2025 Question Paper (Life Sciences - XL)

EE25BTECH11019
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General Aptitude (GA)

1) Even though I had planned to go skiing with my friends, I had to _____ at the last moment because of an injury.

(GATE XL 2025)

a) back up b) back of c) back on d) back out

2) The President, along with the Council of Ministers, _____ to visit India next week.

(GATE XL 2025)

a) will visit b) will wish c) is visiting d) is wishing

3) An electricity utility company charges ₹7 per kWh (kilo watt-hour). If a 40-watt desk light is left on for 10 hours each night for 180 days, what would be the cost of energy consumption? If the desk light is on for 2 more hours each night for the 180 days, what would be the percentage-increase in the cost of energy consumption?

(GATE XL 2025)

a) ₹604.8; 10%
b) ₹504; 20%
c) ₹604.8; 12%
d) ₹720; 15%

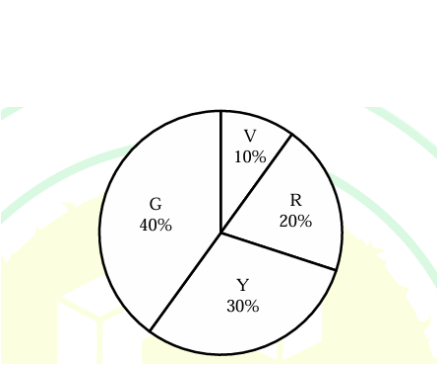
4) In the context of the given figure, which one of the following options correctly represents the entries in the blocks labelled (i), (ii), (iii), and (iv), respectively?

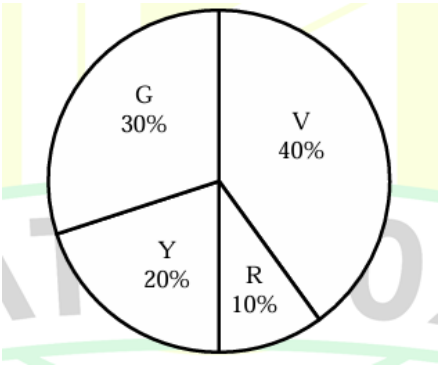
N	U	F	(i)
21	14	9	6
H	L	(ii)	O
12	(iv)	15	(iii)

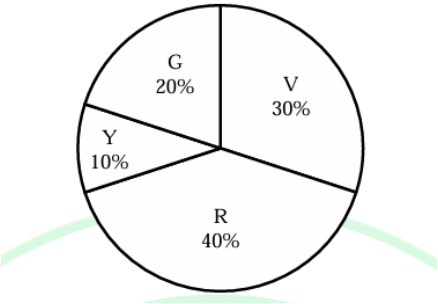
(GATE XL 2025)

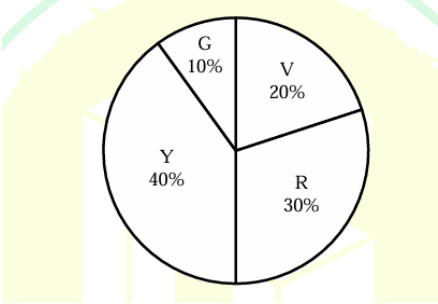
a) Q, M, 12, and 8
b) K, L, 10 and 14
c) I, J, 10, and 8
d) L, K, 12 and 8

5) A bag contains Violet (V), Yellow (Y), Red (R), and Green (G) balls. On counting them, the following results are obtained(:)
(i) The sum of Yellow balls and twice the number of Violet balls is 50.
(ii) The sum of Violet and Green balls is 50.
(iii) The sum of Yellow and Red balls is 50.
(iv) The sum of Violet and twice the number of Red balls is 50.
Which one of the following Pie charts correctly represents the balls in the bag?
(GATE XL 2025)







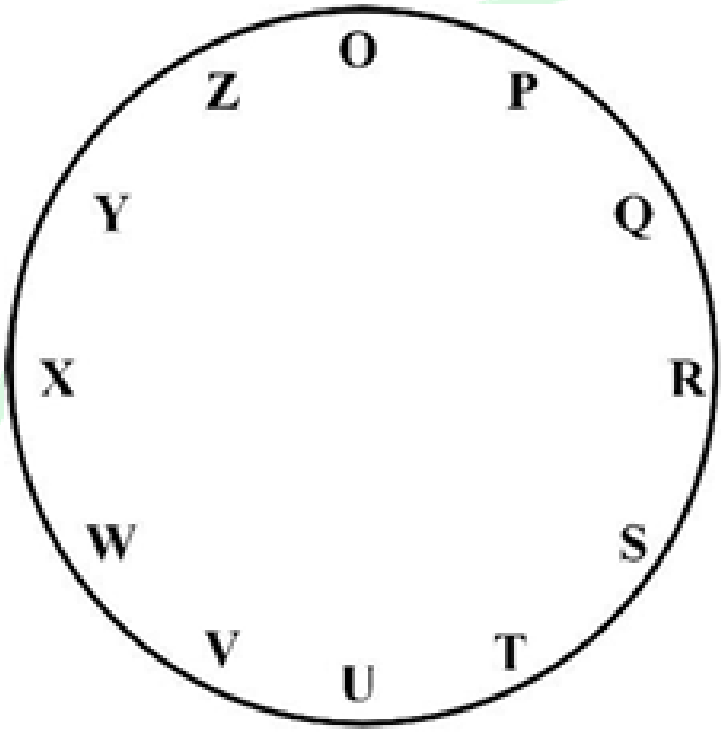


6) "His life was divided between the books, his friends, and long walks. A solitary man, he worked at all hours without much method, and probably courted his fatal illness in this way. To his own name there is not much to show; but such was his liberality that he was continually helping others, and fruits of his erudition are widely scattered, and have gone to increase many a comparative stranger's reputation." (From E.V. Lucas's "A Funeral") Based only on the information provided in the above passage, which one of the following statements is true?

(GATE XL 2025)

a) The solitary man described in the passage is dead.
b) Strangers helped create a grand reputation for the solitary man described in the passage.
c) The solitary man described in the passage found joy in scattering fruits.
d) The solitary man worked in a court where he fell ill.

7) For the clock shown in the figure, if $O = OQSZPRT$, and $X = XZPWYOQ$, then which one among the given options is most appropriate for P?



(GATE XL 2025)

a) PUWRTVX
b) PRTOQSU
c) PTVQSUW
d) PSUPRTV

8) Consider a five-digit number $PQRST$ that has distinct digits P, Q, R, S, and T, and satisfies the following conditions(:) $P < Q$, $S > P > T$, $R < T$. If integers 1 through 5 are used to construct such a number, the value of P is

(GATE XL 2025)

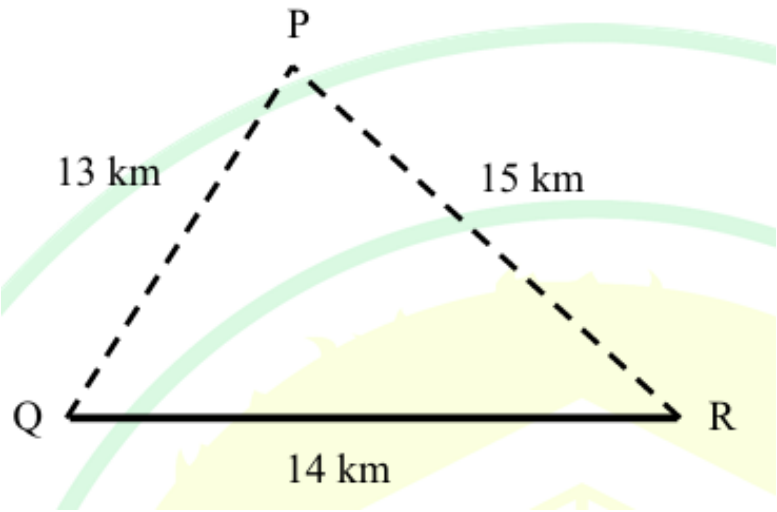
a) 1
b) 2
c) 3
d) 4

9) A business person buys potatoes of two different varieties P and Q, mixes them in a certain ratio and sells them at ₹192 per kg. The cost of the variety P is ₹800 for 5 kg. The cost of the variety Q is ₹800 for 4 kg. If the person gets 8% profit, what is the P: Q ratio (by weight)?

(GATE XL 2025)

a) 5 : 4 b) 3 : 4 c) 3 : 2 d) 1 : 1

10) Three villages P, Q, and R are located in such a way that the distance $PQ = 13$ km, $QR = 14$ km, and $RP = 15$ km, as shown in the figure. A straight road joins Q and R. It is proposed to connect P to this road QR by constructing another road. What is the minimum possible length (in km) of this connecting road?

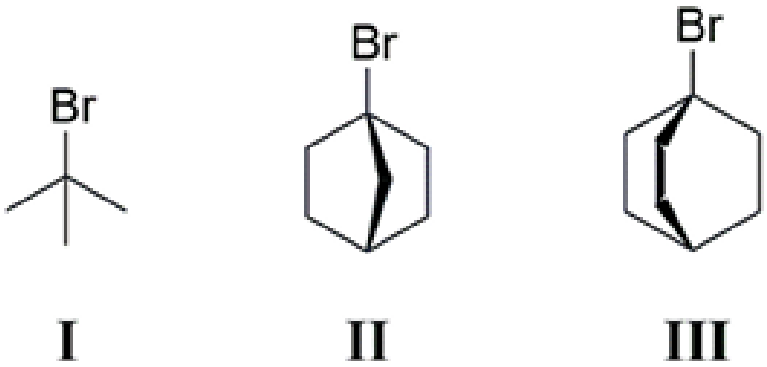


(GATE XL 2025)

a) 10.5 b) 11.0 c) 12.0 d) 12.5

Q. 11 - Q. 19 CARRY ONE MARK EACH.

11) The rate of solvolysis for the following tertiary halides in 80% aqueous ethanol at 25 °C follows the order



Q11 que.

(GATE XL 2025)

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

12) The CORRECT order of boiling points for the hydrogen halides is

(GATE XL 2025)

a) HF > HI > HBr > HCl
b) HF > HCl > HBr > HI
c) HI > HBr > HCl > HF
d) HI > HF > HBr > HCl

13) The bond order in N_2^- species is

(GATE XL 2025)

a) 2
b) 2.5
c) 3
d) 3.5

14) The standard enthalpy of the reaction, C (graphite) + H_2O (g) → CO (g) + H_2 (g) is found to be +131.3 kJ mol^{-1} and the $\Delta_f H^\circ$ value for CO (g) is −110.5 kJ mol^{-1}. The value of $\Delta_f H^\circ$ $\left(\text{in kJ mol}^{-1}\right)$ for H_2O (g) is

(GATE XL 2025)

a) +241.8
b) −241.8
c) +20.8
d) −20.8

15) The temperature dependence of reaction rates is generally given by the Arrhenius equation. A plot of $\ln k_r$ against $1/T$ is a straight line from which the pre-exponential factor A and the activation energy E_a can be determined. The CORRECT option regarding this plot is

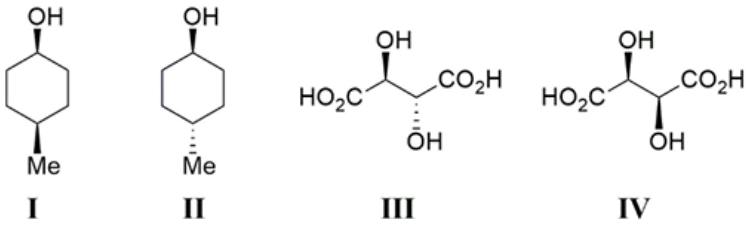
(GATE XL 2025)

a) Slope: $-\frac{E_a}{R}$; Intercept on the y-axis: $\ln A$
b) Slope: $+\frac{E_a}{2.303R}$; Intercept on the y-axis: A
c) Slope: $+\frac{E_a}{R}$; Intercept on the y-axis: A
d) Slope: $-\frac{E_a}{2.303R}$; Intercept on the y-axis: $\ln A$

16) The isothermal expansion of one mole of an ideal gas from V_i to V_f at temperature T occurs in two ways.
Path I: a reversible isothermal expansion;
Path II: free expansion against zero external pressure.
The CORRECT option for the values of ΔU, q and w for Path I and Path II is
(GATE XL 2025)

a) Path I: $\Delta U = 0$, $q > 0$, $w < 0$
Path II: $\Delta U = 0$, $q = 0$, $w = 0$
b) Path I: $\Delta U = 0$, $q > 0$, $w < 0$
Path II: $\Delta U > 0$, $q > 0$, $w = 0$
c) Path I: $\Delta U = 0$, $q < 0$, $w > 0$
Path II: $\Delta U = 0$, $q > 0$, $w < 0$
d) Path I: $\Delta U = 0$, $q < 0$, $w > 0$
Path II: $\Delta U < 0$, $q = 0$, $w = 0$

17) The CORRECT statement(s) regarding the given molecules is(are)



Q17 que.

(GATE XL 2025)

a) Both I and II are achiral molecules.
b) Both II and III are chiral molecules.
c) IV is a chiral molecule.
d) Both III and IV are chiral molecules.

18) The CORRECT statement(s) about $\left([Ni(CN)_4]^{2-}\right)$, $([Ni(CO)_4])$ and $\left([NiCl_4]^{2-}\right)$ is(are)
(Given: Atomic number of Ni: 28)
(GATE XL 2025)

a) $\left([Ni(CN)_4]^{2-}\right)$ is diamagnetic and $\left([NiCl_4]^{2-}\right)$ is paramagnetic.
b) Both $([Ni(CO)_4])$ and $\left([NiCl_4]^{2-}\right)$ are paramagnetic.
c) $\left([Ni(CN)_4]^{2-}\right)$ is square planar and $\left([NiCl_4]^{2-}\right)$ is tetrahedral in shape.

d) All three complexes are paramagnetic.

19) Consider the two pKa values of valine as 2.32 and 9.62. The isoelectric point (pI) of this amino acid is _____ (rounded off to two decimal places).

(GATE XL 2025)

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

20) A few species are given in Column I. Column II contains the hybrid orbitals used by the central atom of the species for bonding. The CORRECT match for the species to their central atom hybridization is

(Given: Atomic numbers of B: 5; C: 6; O: 8; F: 9; P: 15; Cl: 17; I: 53)

(GATE XL 2025)

a) i-d, ii-c, iii-b, iv-a
b) i-d, ii-b, iii-c, iv-a
c) i-d, ii-c, iii-a, iv-b
d) i-c, ii-d, iii-b, iv-a

21) For product formation from only one type of reactant (e.g. A $\rightarrow$ product), the CORRECT match for the order of the reaction (given in Column I) with the half-life expression (given in Column II) is

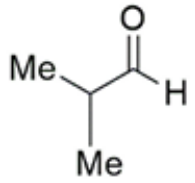
($[A]_0$) is the initial concentration and k_r is the rate constant

(GATE XL 2025)

a) i-R, ii-P, iii-S
b) i-S, ii-R, iii-Q
c) i-Q, ii-P, iii-S
d) i-Q, ii-R, iii-P

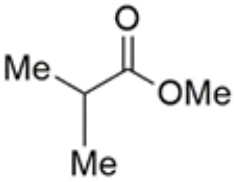
22) The CORRECT statement(s) for the given reactions is(are)

Reactions:

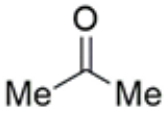
I) 

i) MeMgBr
ii) H_3O^+

II) MeCHO
i) ^{i}PrMgBr
ii) H_3O^+

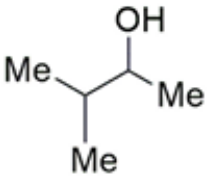
III) 

i) MeMgBr (excess)
ii) H_3O^+

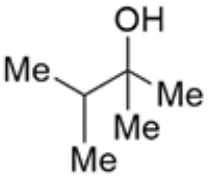
IV) 

i) ^{i}PrMgBr
ii) H_3O^+

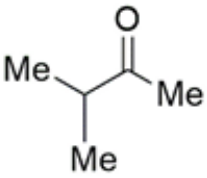
Possible products:



P



Q



R

Q22 que.

(GATE XL 2025)

a) P is formed as the major product in reaction II.
b) Q is formed as the major product in reaction IV.
c) R is formed as the major product in reaction III.
d) P is formed as the major product in reaction I.

23) Addition of a few drops of concentrated HCl to an aqueous solution of $CoCl_2$ forms a dark blue complex X. The CORRECT statement(s) for this reaction is(are)
(Given: Atomic number of Co: 27)

(GATE XL 2025)

a) X is a centrosymmetric complex.
b) The oxidation state of cobalt does not change in this reaction.
c) The number of unpaired electrons on cobalt in X and in $CoCl_2$ (aqueous solution) are the same.
d) The spin only magnetic moment value for X is 3.87 BM.

24) The CORRECT statement(s) regarding biomolecules is(are)

(GATE XL 2025)

a) The N-terminal amino acid of a polypeptide can be identified by Edman's reagent (phenyl isothiocyanate).
b) L-Threonine has only one chiral center.
c) Cytosine is present both in RNA and DNA.
d) A mixture of different amino acids can be separated by ion-exchange chromatography.

25) Energy of the transition from $n = 4$ to $n = 2$ for hydrogen atom is $E \times 10^3$ cm^{-1}.
$\left(\text{Given: Rydberg constant for hydrogen: } 1.097 \times 10^7 \text{ m}^{-1}\right)$
Value of E is _____ (rounded off to two decimal places)

(GATE XL 2025)

26) A non-volatile solute has a molecular weight of 180 g mol^{-1}. Assume that the solute does not associate or dissociate in water, and the boiling-point constant (ebullioscopic constant) of water is 0.51 K kg mol^{-1}.
The amount (in g) of solute added to 500 g of water to elevate the boiling point by 0.153 K is _____ (answer in integer)

(GATE XL 2025)

27) The standard potentials (E°) for the Fe^{3+}/Fe and Fe^{3+}/Fe^{2+} couples are −0.04 V and +0.76 V, respectively.
$\left(\text{Given: Faraday constant } = 96500 \text{ C mol}^{-1}\right)$

(GATE XL 2025)

Biochemistry (XL-Q)

Q.28 - Q.35 carry one mark each.

28) Zinc is essential for the function of

(GATE XL 2025)

a) carboxypeptidase A
b) chlorophyll a
c) myoglobin
d) vitamin B_{12}

29) Which one of the following molecules captures CO_2 in the C_4 cycle?
(GATE XL 2025)

a) 1,3-Bisphosphoglycerate
b) Oxaloacetate
c) Phosphoenolpyruvate
d) Ribulose-1,5-bisphosphate

30) Which one of the following methods separates biomolecules based on their hydrodynamic volumes?
(GATE XL 2025)

a) Anion-exchange chromatography
b) Cation-exchange chromatography
c) Size-exclusion chromatography
d) Thin-layer chromatography

31) Which one of the following restriction endonucleases is a blunt cutter?
(GATE XL 2025)

a) BamHI b) EcoRI c) HindIII d) SmaI

32) Which one of the following DNA repair systems requires DNA glycosylases?
(GATE XL 2025)

a) Base-excision
b) Direct
c) Mismatch excision
d) Nucleotide-

33) Which one of the following ion channels opens to repolarize the neuronal membrane when an action potential is generated?
(GATE XL 2025)

a) Ca^{2+} channel b) H^+ channel c) Na^+ channel d) K^+ channel

34) Which one of the following is the most sensitive immunoassay?
(GATE XL 2025)

a) Immunoelectrophoresis
b) Immunofluorescence
c) Radial immunodiffusion
d) Radioimmunoassay

35) Which of the following statements about antibodies is/are correct?
(GATE XL 2025)

a) Different antibody classes have different effector functions.
b) Each antibody chain consists of an amino-terminal constant region and a carboxy-terminal variable region.
c) Variable domains harbour complementarity-determining regions.
d) Antibodies are produced only by T cells.

Q.36 - Q.46 CARRY TWO MARKS EACH.

36) Which one of the following molecules does NOT contain phosphoanhydride bond(s)? (GATE XL 2025)

a) Adenosine diphosphate
b) Adenosine triphosphate
c) Fructose-1,6-bisphosphate
d) Pyrophosphate

37) For an enzyme that follows Michaelis-Menten kinetics, a competitive inhibitor (GATE XL 2025)

a) increases both K_m and V_{max}
b) decreases both K_m and V_{max}
c) increases K_m but does not affect V_{max}
d) decreases K_m but increases V_{max}

38) FÃ¶rster Resonance Energy Transfer does NOT depend on the (GATE XL 2025)

a) relative orientation of donor and acceptor
b) fluorescence quantum yield of acceptor
c) distance between donor and acceptor
d) overlap between donor's emission and acceptor's absorption spectra

39) Phospholipid vesicles prepared in 50 mM KCl were diluted in water. Based on this information, statements P and Q are made.
P: The diluted vesicles will develop membrane potential.
Q: There is a K^+ concentration difference across the vesicular membrane.
Which one of the following options is correct? (GATE XL 2025)

a) Both P and Q are true.
b) P is true and Q is false.
c) P is false and Q is true.
d) Both P and Q are false.

40) Peptide-binding cleft in MHC-I is formed by (GATE XL 2025)

a) α_1 and α_2 domains
b) α_1 and α_3 domains
c) α_1 domain and β_2-microglobulin
d) α_2 domain and β_2-microglobulin

41) Which of the following peptides do/does NOT absorb ultraviolet light above 250 nm wavelength? (GATE XL 2025)

a) MQRTVWG
b) YDEIGVL
c) PLASNGK
d) CROISRATE

42) Which of the following is/are peptide hormone(s)? (GATE XL 2025)

a) Calcitonin
b) Glucagon
c) Serotonin
d) Thyroxine

43) Which of the following is/are heteropolysaccharide(s)?

(GATE XL 2025)

a) Chondroitin-4-sulfate
b) Chitin
c) Cellulose
d) Heparin

44) The equilibrium dissociation constant of acetic acid is 1.74×10^{-5} M. The pKa of acetic acid _____ (rounded off to one decimal place)

(GATE XL 2025)

45) The DNA double helix measures 0.34 nm/bp. The diameter of a nucleosome core particle is 11 nm. If the ratio of wrapped DNA length to nucleosome diameter is 4.51, the length of DNA around the nucleosome _____ (to the nearest integer) is bp.

(GATE XL 2025)

46) E. coli is grown exclusively in a medium containing $^{15}NH_4Cl$ as the sole nitrogen source. Subsequently, the cells were shifted to a medium containing $^{14}NH_4Cl$. The molar ratio of hybrid DNA (15N-14N) to light DNA (14N-14N) after four generations _____ (rounded off to two decimal places)

(GATE XL 2025)

Botany (XL-R)

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

47) Correctly match the names of the plant taxonomists (Group I) with the titles of the books they authored (Group II).

Group I	**Group II**
P) John Hutchinson	1) Classification of Flowering Plants
Q) Adolf Engler and Karl Prantl	2) Evolution and Classification of Flowering Plants
R) Arthur Cronquist	3) Die Naturlichen Pflanzenfamilien
S) Alfred Barton Rendle	4) The Families of Flowering Plants

(GATE XL 2025)

a) P-4; Q-3; R-2; S-1
b) P-1; Q-3; R-2; S-4
c) P-1; Q-2; R-4; S-3
d) P-2; Q-1; R-4; S-3

48) Identify the CORRECT component of phloem tissue that is living and lacks nucleus at maturity.

(GATE XL 2025)

a) Phloem parenchyma b) Phloem companion c) Phloem sieve element d) Phloem-pole pericycle

49) Correctly match the carnivorous plants (Group I) with the organs (Group II) they modify to trap the prey.

Group I	**Group II**
P) Pitcher plant (*Nepenthes*)	1) Leaf
Q) Bladderwort (*Utricularia*)	2) Fruit
R) Sundew (*Drosera*)	3) Stem
S) Venus flytrap (*Dionaea*)	4) Tendril

(GATE XL 2025)

a) P-1; Q-2; R-3; S-1
b) P-1; Q-1; R-1; S-1
c) P-2; Q-2; R-2; S-2
d) P-2; Q-4; R-1; S-1

50) Which one of the following compounds is produced only by the members of the plant kingdom?

(GATE XL 2025)

a) Cellulose b) Pectin c) Chitin d) Starch

51) Which one of the following agents causes the necrotic ring spot disease in stone fruits?

(GATE XL 2025)

a) Fungi b) Bacteria c) Virus d) Nematodes

52) Identify the correct statement(s) with respect to plant disease.

(GATE XL 2025)

a) Hairy root disease in tobacco is caused by *Agrobacterium tumefaciens*
b) Loose smut of barley is caused by *Ustilago nuda*
c) Stem rust of grape is caused by *Plasmopara viticola*
d) Fire blight in pear is caused by *Erwinia amylovora*

53) Which of the following molecular approaches can be used to generate complete knock-out of a target gene in plants?

(GATE XL 2025)

a) Homologous recombination
b) CRISPR-Cas9
c) Antisense RNA technique
d) Activation tagging

54) If an egg cell of a diploid plant species has 10 chromosomes, the expected number of chromosomes in a double trisomic somatic cell of this species would be _____.

(GATE XL 2025)

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

55) In the history of photosynthetic research, the empirical reaction of photosynthesis was first proposed for green plants (equation 1), followed by another reaction for purple sulfur bacteria (equation 2), leading to a generalized equation for photosynthesis (equation 3):

$$CO_2 + H_2O \xrightarrow{\text{light}} (CH_2O) + O_2 \quad \text{(equation 1)}$$

$$CO_2 + 2H_2S \xrightarrow{\text{light}} (CH_2O) + H_2O + 2S \quad \text{(equation 2)}$$

$$CO_2 + 2H_2A \xrightarrow{\text{light}} (CH_2O) + H_2O + 2A \quad \text{(equation 3)}$$

(GATE XL 2025)

a) The source of oxygen produced in photosynthesis in green plants is CO_2
b) The source of oxygen produced in photosynthesis in green plants is H_2O
c) Light is essential in every form of photosynthesis
d) Glucose is the end product in all forms of photosynthesis

56) Consider a diploid plant species where the cells in the epidermis (the outermost single cell layer) always divide in the anticlinal orientation. If one such cell within the central zone of the shoot apical meristem (SAM) spontaneously becomes tetraploid at the seedling stage, which one of the following cellular arrangements would be most likely observed at the adult stage?

(GATE XL 2025)

a) Only one tetraploid cell in the epidermis
b) Many tetraploid cells in the epidermis
c) All cells in the entire SAM tetraploid
d) All cells in the entire SAM diploid

57) Correctly match the photosynthetic pathways (Group I) with their first stable products (Group II) in respective plants (Group III).

Group I	**Group II**	**Group III**
P) C_3 cycle	1) 3-Phosphoglycerate	a) Wheat
Q) C_4 cycle	2) Glyceraldehyde-3-phosphate	b) Sugarcane
R) CAM	3) Oxaloacetate	c) Pineapple

(GATE XL 2025)

a) P-1-a; Q-3-b; R-3-c
b) P-1-a; Q-2-b; R-3-c
c) P-1-b; Q-3-a; R-2-c
d) P-1-b; Q-2-c; R-2-a

58) The following table summarizes the flowering time behavior (days to flower) and the transcript levels in four genotypes of a plant species. Which one of the following genetic pathways best explains the observations shown in the table?

Genotype	**Days to flower**	**Transcript level of gene A**	**Transcript level of gene**
Wild type	30	Normal	Normal
a mutant	15	Nil	Increased
b mutant	60	Normal	Nil
ab double mutant	60	Nil	Nil

(GATE XL 2025)

a) A gene activates B, which suppresses flowering transition
b) A gene suppresses B, which promotes flowering transition
c) B gene activates A, which suppresses flowering transition
d) B gene suppresses A, which promotes flowering transition

59) Correctly match the economically important specialized metabolites (Group I) with their broad chemical classes (Group II).

Group I	**Group II**
P) Azadirachtin	1) Monoterpene
Q) Saponin	2) Alkaloid
R) Gallocatechin	3) Triterpene glycoside
S) Cocaine	4) Polyphenol
T) Menthol	5) Triterpene

(GATE XL 2025)

a) P-5; Q-3; R-2; S-4; T-1
b) P-2; Q-4; R-3; S-1; T-5
c) P-5; Q-3; R-4; S-2; T-1
d) P-3; Q-5; R-4; S-2; T-1

60) Correctly match the following *Arabidopsis* genes (Group I) and the biological processes they primarily regulate (Group II).

Group I	**Group II**
P) CLAVATA3	1) Organ identity in flower
Q) CONSTANS	2) Cell-type specification in root meristem
R) SCARECROW	3) Meristem size in shoot
S) AGAMOUS	4) Photoperiodic floral transition

a) P-3; Q-4; R-1; S-2
b) P-1; Q-3; R-2; S-4
c) P-3; Q-4; R-2; S-1
d) P-4; Q-1; R-3; S-2

61) Correctly match the enzymes used as selectable markers (Group I) and the chemicals used for their selection (Group II).

Group I	**Group II**
P) Neomycin phosphotransferase	1) Bialaphos
Q) Phosphinothricin acetyltransferase	2) Kanamycin
R) Dihydrofolate reductase	3) Glyphosate
S) 5-Enolpyruvyl shikimate 3-phosphate synthase	4) Methotrexate

(GATE XL 2025)

a) P-2; Q-1; R-4; S-3
b) P-1; Q-2; R-3; S-4
c) P-2; Q-4; R-1; S-3
d) P-3; Q-4; R-1; S-2

62) Which of the following sequential reactions correctly represent(s) the flow of electrons from NADH to O_2 in plant mitochondrial electron transport chain?
(GATE XL 2025)

a) NADH dehydrogenase → Ubiquinone → Succinate dehydrogenase → Cytochrome bc_1 → Cytochrome c → Cytochrome c oxidase
b) NADH dehydrogenase → Succinate dehydrogenase → Ubiquinone → Cytochrome c → Cytochrome bc_1 → Cytochrome c oxidase
c) NADH dehydrogenase → Ubiquinone → Alternative oxidase
d) NADH dehydrogenase → Alternative oxidase → Ubiquinone

63) If rabbits are introduced in an isolated grassland for the first time, which of the following growth curves (shown using dashed line) is/are theoretically possible population dynamics over time?

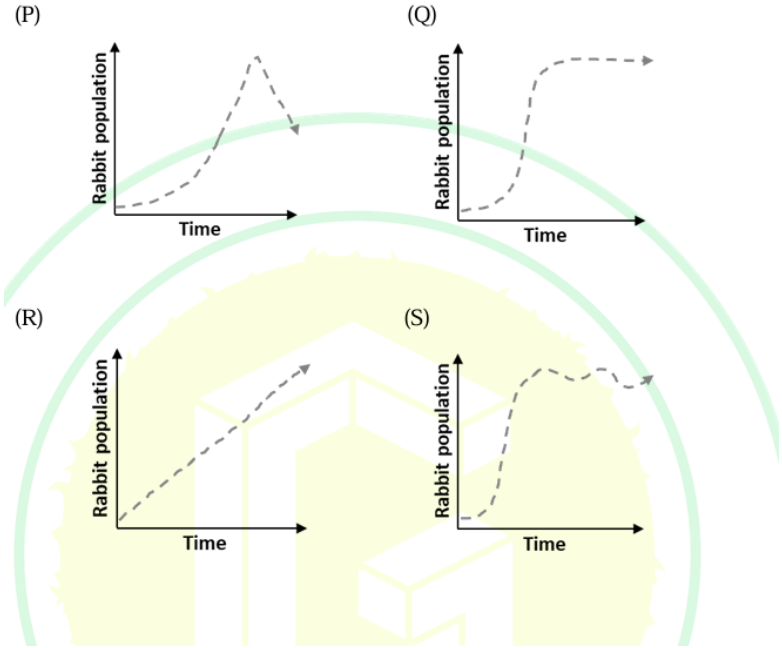


Fig. 1: Q63 que.

(GATE XL 2025)

a) P b) Q c) R d) S

64) Which of the following reactions in plants is/are catalyzed by the malic enzymes?
(GATE XL 2025)

a) Malate + $NAD^+ \rightarrow$ Pyruvate + CO_2 + NADH
b) Malate + NAD^+ = Oxaloacetate + NADH
c) Malate = Fumarate
d) Malate + $NADP^+ \rightarrow$ Pyruvate + CO_2 + NADPH

65) In a genetic cross between a true-breeding tall parent bearing red flowers and a true-breeding dwarf parent bearing white flowers, only tall plants with red flowers are obtained in the F_1 population. Considering these two traits segregate independently, if one tall individual is selected from the F_2 population, the probability that it would be genotypically homozygous for plant height and make red flowers is _____.
(GATE XL 2025)

Microbiology (XL-S)

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

66) Which one of the following metabolites is associated with bacterial stringent response?

a) Cyclic di-GMP (CDG)
b) Guanosine tetraphosphate (ppGpp)
c) Cyclic-AMP (cAMP)
d) Cyclic-GMP (cGMP)

67) India is aiming to be free of tuberculosis by 2025. One of the key approaches for this program is DOTS. Which one of the following options is the full form of DOTS?
(GATE XL 2025)

a) Directly observed therapy short-course
b) Directly observed tuberculosis short-course
c) District operated therapy system
d) Directly operated therapy short-course

68) Correctly match the bacterial type in Column I with their corresponding environmental niche in Column II.

Column I	**Column II**
P) Psychrophile	i) Pressure greater than 380 atm
Q) Barophile	ii) Temperature between 15 °C and 45 °C
R) Mesophile	iii) Temperature below 15 °C
S) Halophile	iv) pH less than 3.0
	v) Salt concentration greater than 2 M

(GATE XL 2025)

a) P-iii; Q-i; R-ii; S-v
b) P-ii; Q-iii; R-i; S-v
c) P-i; Q-iv; R-iii; S-v
d) P-v; Q-iii; R-iv; S-i

69) Robert Koch used a meat-infused nutrient medium for which one of the following purposes?
(GATE XL 2025)

a) To grow disease causing microorganisms
b) To demonstrate presence of microorganisms in air
c) To test the efficiency of sterilization approaches
d) To demonstrate antimicrobial activity of soil isolates

70) A penicillin sensitive *Escherichia coli* population is exposed to a lethal dose (200 μg/mL) of penicillin. Assuming density-independent mortality, which one of the following relationships would describe the number of surviving bacteria (N) over time (T)?
(GATE XL 2025)

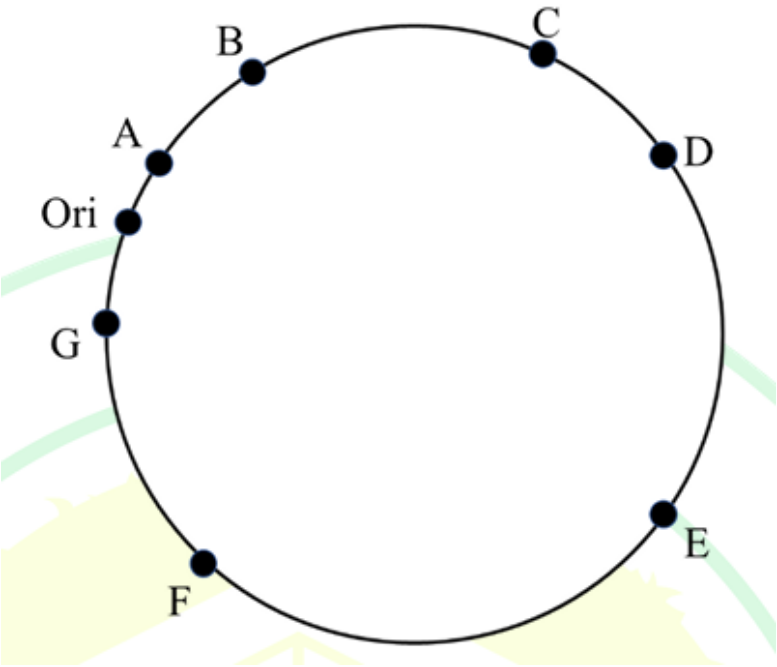
a) Exponential b) Linear c) Sigmoidal d) parabolic

71) A bacterium obtains energy from a chemical source by the oxidation of reduced NO_2, with CO_2 as the principal carbon source. Which one of the following nutritional groups does this bacterium belong to?

(GATE XL 2025)

a) Photoautotroph b) Photoheterotroph c) Chemoautotroph d) Chemoheterotroph

72) The origin of the *Escherichia coli* chromosome on the genetic map is shown below. Bidirectional replication is a feature of this system and both replication forks move at the same rate. Which one of the following sequences of replication of the genes is correct?



(GATE XL 2025)

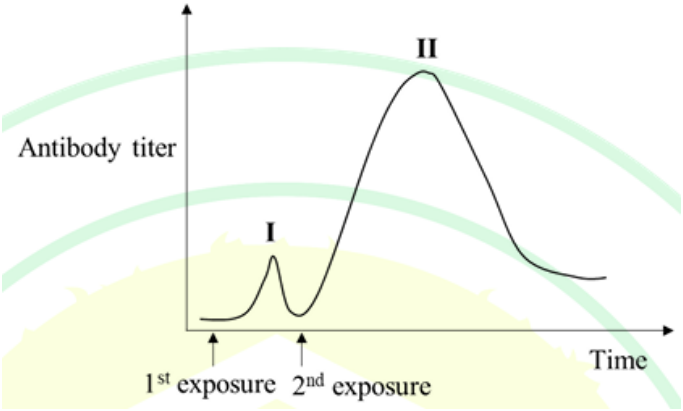
a) ABCDEFG b) AGBFCDE c) GAFBECD d) GAFEBCD

73) Which of the following sites is/are the location(s) of ATP generation through oxidative phosphorylation in *Escherichia coli*?

a) Inner membrane only
b) Outer membrane only
c) Both outer membrane and inner membrane
d) Mesosome

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

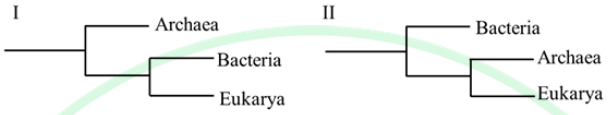
74) The adaptive immune response in an animal involves the generation of antibodies against an invading bacterial pathogen. The following graph represents antibody titer levels in a mammal exposed twice to the pathogen. Which one of the following options correctly pairs antibodies to peak I and peak II in the graph?



(GATE XL 2025)

a) Peak I - IgG; Peak II - IgM
b) Peak I - IgM; Peak II - IgG
c) Peak I - IgE; Peak II - IgG
d) Peak I - IgM; Peak II - IgE

75) Carl Woese established that short subunit rRNA sequences can be used to reveal evolutionary relationships between various organisms. Based on this, which one of the following options is the established phylogenetic arrangement of the three domains of life?



(GATE XL 2025)

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

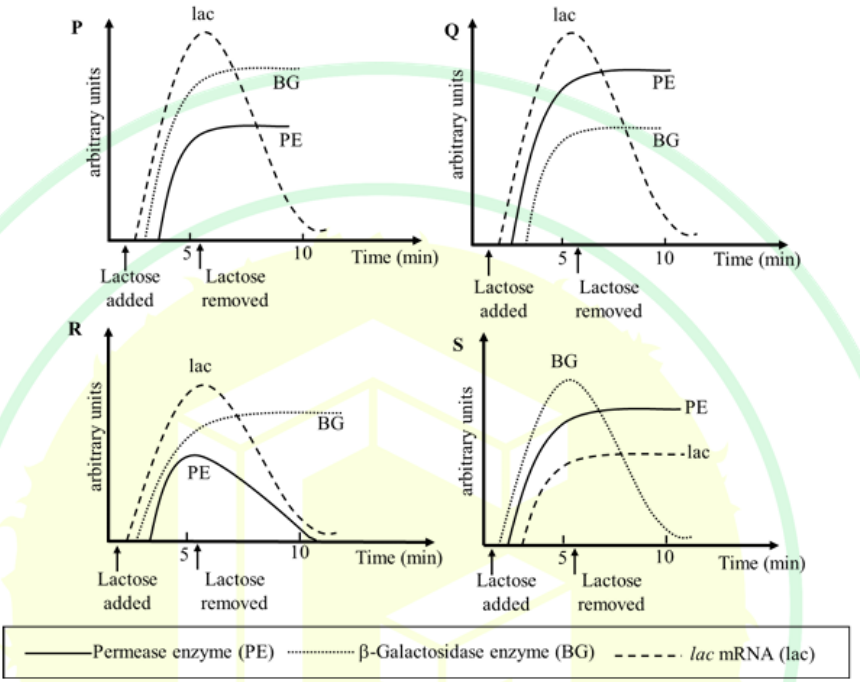
76) Correctly match the viruses listed in Column I with the nature of their corresponding genetic materials listed in Column II.

Column I	**Column II**
P) Bacteriophage lambda	i) dsDNA
Q) Bacteriophage M13	ii) ssDNA
R) Coronavirus	iii) ssRNA
S) Reovirus	iv) dsRNA

(GATE XL 2025)

a) P-i; Q-iv; R-iii; S-ii
b) P-iv; Q-ii; R-i; S-iii
c) P-i; Q-ii; R-iii; S-iv
d) P-i; Q-iii; R-ii; S-iv

77) A culture of lac$^+$ *Escherichia coli* is grown in a medium lacking lactose or any other β-galactoside. The response of the lac operon upon induction by lactose can be monitored by measuring the levels of lac mRNA, β-galactosidase enzyme and permease enzyme. Which one of the following profiles correctly captures the on-off response to lactose?



(GATE XL 2025)

a) P b) Q c) R d) S

78) Which option(s) correctly match(es) the structures in a bacterial cell (Column I) with their corresponding functions (Column II).

Column I	**Column II**
P) Cell wall	i) Protection from osmotic stress
Q) Fimbriae	ii) Attachment to surfaces
R) Flagella	iii) Motility
S) Pili	iv) Transfer of genetic material

(GATE XL 2025)

a) P-i; Q-ii; R-iii; S-iv
b) P-i; Q-iii; R-iii; S-iv
c) P-i; Q-iv; R-ii; S-iii
d) P-ii; Q-iv; R-i; S-iii

79) Which of the following statements regarding micro-organisms is/are correct?
(GATE XL 2025)

a) The free-living bacterium *Wolbachia* is a human parasite.
b) *Myxococcus* are a group of predatory bacteria.
c) *Dictyostelium* is a slime mold that aggregates to form social groups.
d) Actinomycetes in soil are involved in producing earthy odours.

80) Which of the following is/are example(s) of animal-microbe mutualism?

(GATE XL 2025)

a) Human - *Mycobacterium tuberculosis*
b) Dog - Rabies lyssavirus
c) Human - *Lactobacillus plantarum*
d) Cow - *Methanobrevibacter ruminantium*

81) Which of the following reactions is/are catalyzed by aldolase?

(GATE XL 2025)

a) Dihydroxyacetone phosphate + Glyceraldehyde-3-phosphate → Fructose-1,6-bisphosphate
b) Dihydroxyacetone phosphate + Erythrose-4-phosphate → Sedoheptulose-1,7-bisphosphate
c) Dihydroxyacetone phosphate → Glyceraldehyde-3-phosphate
d) Glyceraldehyde-3-phosphate + Erythrose-4-phosphate → Sedoheptulose-1,7-bisphosphate

82) Which option(s) correctly match(es) the Antibiotic with their corresponding Target?

Antibiotic	**Target**
P) Penicillin	i) Ribosome
Q) Kanamycin	ii) RNA polymerase
R) Rifampicin	iii) DNA gyrase
S) Nalidixic acid	iv) Transpeptidase
T) Ciprofloxacin	

(GATE XL 2025)

a) P-iv; Q-i; R-ii; S-iii
b) P-ii; Q-iv; R-i; S-iii
c) P-iv; Q-i; R-ii; T-iii
d) P-iv; Q-iii; R-ii; T-i

83) The doubling time of *Escherichia coli* is 30 minutes in a culture medium containing glucose and yeast extract. Phage T7 has a life cycle of 20 minutes and a burst size of 200 phage per infected *E. coli* cell. Phage absorption is instantaneous and occurs at 1 multiplicity of infection (MOI). Bacteria infected with multiple or single phage give the same burst. 5000 plaque forming units of T7 phage are added to a culture of 2×10^7 *E. coli* cells.
Assuming normal division, the *E. coli* culture will lyse completely by _____ full cycles of bacterial division.

(GATE XL 2025)

84) A polymerase chain reaction (PCR) based diagnosis test was performed on a bacterial sample targeting a specific gene. There are 3 copies of this gene in the bacterial genome. Prior to DNA extraction, the bacteria were incubated to allow one cycle of growth. 3072 amplicon copies were obtained after 9 cycles of the PCR. Assume 100% efficiency at each step.
The initial bacterial count in the sample was _____.

(GATE XL 2025)

Zoology (XL-T)

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

85) Which one of the following is a "brood parasite"?

(GATE XL 2025)

a) Pigeon b) Sparrow c) Goose d) Cuckoo

86) During the development of a mammalian embryo, "yolk sac" is formed by which one of the following?

(GATE XL 2025)

a) Syncytiotrophoblast derm (hypoblast) derm epiblast
b) Primitive endo-c) Amniotic ecto-d) Embryonic

87) The animals belonging to which one of the following phyla are characterized by "segmented body"?

(GATE XL 2025)

a) Annelida
b) Cnidaria
c) Echinodermata
d) Porifera

88) Which one of the following is a "post-zygotic" isolating mechanism of speciation?

(GATE XL 2025)

a) Behavioral isolation
b) Fertilization failure
c) Hybrid sterility
d) Seasonal isolation

89) Desmosomes are

(GATE XL 2025)

a) Intermediate filament-based cell adhesion complexes
b) Protein synthesizing macromolecular complexes
c) Subcellular organelles
d) DNA-protein complexes

90) The "foramen of Panizza" is found in which one of the following groups of animals?

(GATE XL 2025)

a) Fishes b) Crocodiles c) Frogs d) Dolphins

91) Imagine a population of diploid species in Hardy-Weinberg equilibrium. The population has two alleles for a gene which are *a* and *A*. The number of individuals with *aa* genotype in this population is 1 in 10000. The frequency of the allele *A* in the population is _____ (up to two decimal places).

(GATE XL 2025)

92) A PCR was set up to amplify a 500 nucleotides-long DNA. The dNTPs in the reaction mixture were radiolabeled. The percentage of radiolabeled single-stranded DNA after three cycles will be _____ (up to one decimal place).

(GATE XL 2025)

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

93) Match the molecules in Column-I with their properties/functions mentioned in Column-II.

Column-I	**Column-II**
P) IgM	1) Involved in antigen presentation
Q) IgE	2) Predominant antibody type in various body secretions
R) IgA	3) Can pass through placenta
S) MHC	4) Associated with allergic reaction
	5) Contains ten heavy and light chains

(GATE XL 2025)

a) P-3; Q-2; R-4; S-5
b) P-5; Q-4; R-2; S-1
c) P-2; Q-3; R-4; S-1
d) P-4; Q-1; R-3; S-5

94) Match the following human diseases in Column-I with their causal organism in Column-II.

Column-I	**Column-II**
P) Sleeping sickness	1) *Trypanosoma cruzi*
Q) Chagas disease	2) *Trypanosoma brucei*
R) Elephantiasis	3) *Borrelia burgdorferi*
S) Lyme disease	4) *Wuchereria bancrofti*
	5) *Rickettsia rickettsii*

(GATE XL 2025)

a) P-3; Q-1; R-4; S-5
b) P-1; Q-2; R-3; S-4
c) P-2; Q-4; R-1; S-3
d) P-2; Q-1; R-4; S-3

95) Match the molecules in Column-I with their correct property/function in Column-II.

Column-I	**Column-II**
P) RNase P	1) rRNA gene transcription
Q) RNA Polymerase-I	2) Gene silencing
R) siRNA	3) Cas9-mediated genome editing
S) Guide RNA	4) Ribozymes
	5) tRNA gene transcription

(GATE XL 2025)

a) P-4; Q-5; R-2; S-3
b) P-5; Q-1; R-3; S-4
c) P-4; Q-1; R-2; S-3
d) P-5; Q-4; R-1; S-2

96) What would be the number of genotypes and phenotypes, respectively, from a cross between genotypes AaBBCcDd and AaBBCcDd? Assume independent assortment and simple dominant-recessive relationship in each gene pair.

(GATE XL 2025)

a) 8 and 4
b) 12 and 4
c) 27 and 8
d) 14 and 8

97) Nucleosomes are made up of DNA and histones. Histones undergo various kinds of modifications by different groups of proteins. They are known as histone writers, readers and erasers. Which of the following is/are histone writer(s)?

(GATE XL 2025)

a) Histone acetyl transferases
b) Histone methyl transferases
c) Histone deacetylases
d) DNA methyl transferases

98) The expression of a gene is regulated by a transcription factor. Which of the following techniques can be used to identify the region in its promoter where the transcription factor binds?

(GATE XL 2025)

a) S1 nuclease mapping
b) Chromatin immunoprecipitation followed by sequencing
c) Electrophoretic mobility shift assay
d) DNase I footprinting

99) Which of the following animals in India are included under “critically endangered” threat category as per the Red Data List of IUCN?

(GATE XL 2025)

a) Namdapha Flying Squirrel
b) Indian Rhinoceros
c) Nicobar Shrew
d) Clouded Leopard

100) Which of the following statements in relation to cell movement during gastrulation in Sea urchin is/are correct?

(GATE XL 2025)

a) Delamination leads to the formation of endoderm
b) Ingression leads to the development of mesoderm
c) Involution leads to the development of ectoderm
d) Invagination leads to the development of endoderm

101) Which of the following genetic disorders is/are caused by trinucleotide repeat expansions?

(GATE XL 2025)

a) Huntington's disease
b) β-thalassemia
c) Fragile X syndrome
d) Cystic fibrosis

102) The mother and the father of five children are carriers (heterozygous) of an autosomal recessive allele that causes cystic fibrosis. The probability of having exactly three normal children among five is _____.

(GATE XL 2025)

103) An enzyme, which follows Michaelis-Menten equation, catalyzes the reaction A $\rightarrow$ B. When enzyme and substrate concentrations are 15nM and 10 μM, respectively, the reaction velocity is 5 μMs^{-1}. If K_m for the substrate A is 5 μM, the kinetic efficiency of the enzyme will be $\times 10^6$M^{-1}s^{-1} _____.

(GATE XL 2025)

Food Technology (XL-U)

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

104) Which of the following contains the phytonutrient allicin?

(GATE XL 2025)

a) Grape b) Cauliflower c) Garlic d) Chilli

105) Which mold is responsible for the characteristic blue marbling in blue-veined cheese?

(GATE XL 2025)

a) *Rhizopus oryzae*
b) *Penicillium roqueforti*
c) *Aspergillus niger*
d) *Penicillium camemberti*

106) Which genus of bacteria does NOT have cell wall?

(GATE XL 2025)

a) *Lactobacillus* b) *Staphylococcus* c) *Mycoplasma* d) *Escherichia*

107) Which of the following pigments does NOT have pro-vitamin A activity?
(GATE XL 2025)

a) β-Carotene
b) β-Cryptoxanthin
c) Lycopene
d) α-Carotene

108) Identify the analysis that must be performed FIRST to judge cleanliness of spice/herb powders.
(GATE XL 2025)

a) Acid-insoluble ash content
b) Pesticide residue levels
c) Volatile oil content
d) Mycotoxin levels

109) If there is a delay in oil extraction after bran is separated from the brown rice, the quality of rice bran oil deteriorates. Identify the suitable CAUSE and EFFECT for the deterioration in oil quality.
(GATE XL 2025)

a) Lipase activity; increase in FFA
b) Oil hydrolysis; decrease in FFA
c) Lipase activity; decrease in FFA
d) Bran stabilization; decrease in lipase activity

110) Among the following, which is/are the process(es) that lead to generation of new fats from existing ones?
(GATE XL 2025)

a) Transesterification
b) Degumming
c) Hydrogenation
d) Winterization

Q.111 - Q.122 CARRY TWO MARKS EACH.

111) The true density and bulk density of wheat grains are 1280 kg/m^3 and 740 kg/m^3, respectively. The porosity of the grains is _____ (rounded off to 2 decimal places).
(GATE XL 2025)

112) Identify the gas composition (in percent) suitable for packaging cured meat under MAP conditions.
(GATE XL 2025)

a) $O_2 = 0$; $CO_2 = 50$; $N_2 = 50$
b) $O_2 = 50$; $CO_2 = 0$; $N_2 = 50$
c) $O_2 = 0$; $CO_2 = 0$; $N_2 = 100$
d) $O_2 = 50$; $CO_2 = 50$; $N_2 = 0$

113) Which of the following sequence of events occurs during formation of egg-white gel?

Assume: PN = Native protein; PD = Denatured protein; PA = Aggregated protein; PG = Protein gel; $\rightarrow$ = forward reaction; $\leftrightarrow$ = reversible reaction; Δ = heating; ∇ = cooling.

(GATE XL 2025)

a) Δ PN $\rightarrow$ PD $\rightarrow$ PA $\rightarrow$ PG
b) PN $\rightarrow$ PD $\rightarrow$ PG
c) Δ PN $\rightarrow$ PD $\rightarrow$ PG
d) Δ PN $\rightarrow$ PA $\rightarrow$ PG

114) In canning and retorting of foods, which of the following is the correct expression of Ball process time (B)?
Assume: t_p = processor's process time; t_c = come-up time.

(GATE XL 2025)

a) $B = t_p + 0.42\, t_c$
b) $B = t_p + 0.30\, t_c$
c) $B = t_p + 0.50\, t_c$
d) $B = t_p + 0.25\, t_c$

115) Which of the following is the most suitable flexible packaging laminate for dry fruits?

(GATE XL 2025)

a) PET/LDPE
b) PS/LDPE
c) OPP/LDPE
d) Nylon/LDPE

116) Identify the CORRECT sequence of operations for dressing of poultry.

(GATE XL 2025)

a) Slaughtering and bleeding $\rightarrow$ scalding $\rightarrow$ defeathering $\rightarrow$ eviscerating $\rightarrow$ chilling
b) Slaughtering and bleeding $\rightarrow$ defeathering $\rightarrow$ scalding $\rightarrow$ eviscerating $\rightarrow$ chilling
c) Slaughtering and bleeding $\rightarrow$ eviscerating $\rightarrow$ defeathering $\rightarrow$ scalding $\rightarrow$ chilling
d) Slaughtering and bleeding $\rightarrow$ defeathering $\rightarrow$ eviscerating $\rightarrow$ scalding $\rightarrow$ chilling

117) Which of the following statement(s) is/are TRUE for a package of gamma-irradiated (7.5 kGy) whole chicken?

(GATE XL 2025)

a) Nutritional quality of the product deteriorates after irradiation.
b) Spores of *C. botulinum* can survive in the irradiated product.
c) 'Radura' symbol does not ensure safety of the irradiated product for consumption.
d) Energy needed for the irradiation process is much higher than that required for freezing of the product.

118) Match the following food products in Column-I with their corresponding processes in Column-II.

Column-I	Column-II
P) Idli	1) Baking
Q) Parboiled rice	2) Fermentation
R) Soda beverage	3) Gelatinization
S) Cookies	4) Carbonation

(GATE XL 2025)

a) P-2; Q-3; R-4; S-1
b) P-3; Q-2; R-4; S-1
c) P-2; Q-4; R-1; S-3
d) P-2; Q-3; R-1; S-4

119) Which one of the following is used as a chelating agent in foods?
(GATE XL 2025)

a) Citric acid b) EDTA c) Mannitol d) Ascorbic acid

120) Match the following enzymes in Column-I with their applications in Column-II.

Column-I	Column-II
P) β-Glucanase	1) Fruit juice clarification
Q) α- and β-Amylases	2) Bread making
R) Pectinase	3) Meat tenderization
S) Papain	4) Brewing

(GATE XL 2025)

a) P-3; Q-1; R-2; S-4
b) P-4; Q-2; R-1; S-3
c) P-2; Q-4; R-1; S-3
d) P-1; Q-2; R-3; S-4

121) The F_{121} value of a known microorganism with Z value of 11 °C is 2.4min for 99.9999% inactivation. For a 12D inactivation of the said microorganism at 143 °C, the F value (in min) is _____ (rounded off to 3 decimal places).
(GATE XL 2025)

122) In a typical grinding operation, 80% of the feed material passes through a sieve opening of 4.75mm; whereas, 80% of the ground product passes through 0.5mm opening. If the power required to grind 2tonnes/h of the feed material is 3.8kW, the work index of the material is _____ (rounded off to 2 decimal places).
(GATE XL 2025)