Q. 1 – Q. 5 carry one mark each.

Q.1 Once the team of analysts identify the problem, we _____ in a better position to comment on the issue.

Which one of the following choices CANNOT fill the given blank?

(A) will be
(B) were to be
(C) are going to be
(D) might be

Q.2 A final examination is the _____ of a series of evaluations that a student has to go through.

(A) culmination
(B) consultation
(C) desperation
(D) insinuation

Q.3 If IMHO = JNIP; IDK = JEL; and SO = TP, then IDC = ____.

(A) JDE
(B) JED
(C) JDC
(D) JCD

Q.4 The product of three integers X, Y and Z is 192. Z is equal to 4 and P is equal to the average of X and Y. What is the minimum possible value of P?

(A) 6
(B) 7
(C) 8
(D) 9.5

Q.5 Are there enough seats here? There are _____ people here than I expected.

(A) many
(B) most
(C) least
(D) more

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Q. 6 – Q. 10 carry two marks each.

Q.6 Fiscal deficit was 4% of the GDP in 2015 and that increased to 5% in 2016. If the GDP increased by 10% from 2015 to 2016, the percentage increase in the actual fiscal deficit is ___.

(A) 37.50 (B) 35.70 (C) 25.00 (D) 10.00

Q.7 Two pipes P and Q can fill a tank in 6 hours and 9 hours respectively, while a third pipe R can empty the tank in 12 hours. Initially, P and R are open for 4 hours. Then P is closed and Q is opened. After 6 more hours R is closed. The total time taken to fill the tank (in hours) is ____.

(A) 13.50 (B) 14.50 (C) 15.50 (D) 16.50

Q.8 While teaching a creative writing class in India, I was surprised at receiving stories from the students that were all set in distant places: in the American West with cowboys and in Manhattan penthouses with clinking ice cubes. This was, till an eminent Caribbean writer gave the writers in the once-colonised countries the confidence to see the shabby lives around them as worthy of being "told".

The writer of this passage is surprised by the creative writing assignments of his students, because _____.

(A) Some of the students had written stories set in foreign places
(B) None of the students had written stories set in India
(C) None of the students had written about ice cubes and cowboys
(D) Some of the students had written about ice cubes and cowboys

Q.9 Mola is a digital platform for taxis in a city. It offers three types of rides – Pool, Mini and Prime. The Table below presents the number of rides for the past four months. The platform earns one US dollar per ride. What is the percentage share of revenue contributed by Prime to the total revenues of Mola, for the entire duration?

Type	**Month**			
	January	**February**	**March**	**April**
Pool	170	320	215	190
Mini	110	220	180	70
Prime	75	180	120	90

(A) 16.24 (B) 23.97 (C) 25.86 (D) 38.74

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Q.10 X is an online media provider. By offering unlimited and exclusive online content at attractive prices for a loyalty membership, X is almost forcing its customers towards its loyalty membership. If its loyalty membership continues to grow at its current rate, within the next eight years more households will be watching X than cable television.

Which one of the following statements can be inferred from the above paragraph?

(A) Most households that subscribe to X's loyalty membership discontinue watching cable television
(B) Non-members prefer to watch cable television
(C) Cable television operators don't subscribe to X's loyalty membership
(D) The X is cancelling accounts of non-members

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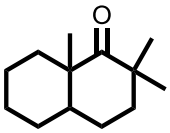
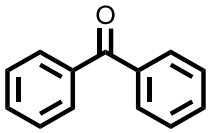
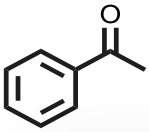
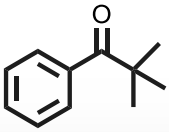
XL-P: Q. 1 – Q. 5 carry one mark each & Q. 6 – Q. 15 carry two marks each

Q.1 The compound that provides a carboxylic acid, upon treatment with Br_2 / NaOH followed by acidification, is.

(A) 

(B) 

(C) 

(D) 

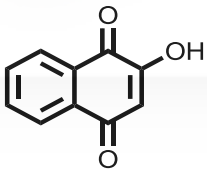
Q.2 The boiling point of halogens from F_2 to I_2 increases due to

(A) decrease in electron affinity
(B) decrease in ionization potential
(C) dipole-dipole interaction
(D) induced dipole – induced dipole interaction

Q.3 According to VSEPR theory, the species that has the smallest F-X-F angle (where X = central atom) is
.

(A) BF_3 (B) PF_3 (C) BF_4^- (D) IF_4^-

Q.4 The total number of tautomers for the following molecule (including the structure provided below) is _____.



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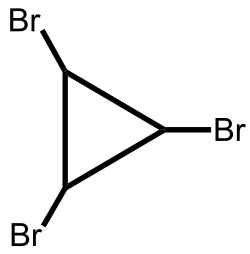
Q.5 The total number of stereoisomers possible for the following structure is ____



Q.6 For the reaction mechanism,

$$2X \rightleftharpoons Y \qquad \text{For this step, assume } K_{eq} = [Y]/[X]^2$$

$$Y \longrightarrow P \qquad \text{k: rate constant for this step}$$

the rate law is .

(A) $\frac{d[P]}{dt} = K_{eq}[Y]$

(B) $\frac{d[P]}{dt} = k\,[X]^2$

(C) $\frac{d[P]}{dt} = k\,K_{eq}[Y]$

(D) $\frac{d[P]}{dt} = k\,K_{eq}\,[X]^2$

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Q.7 Match the type of reaction in Group-1 with the most appropriate description in Group-2

	Group 1		Group 2
P	Hydroboration-oxidation	1	Electrophilic aromatic substitution
Q	Nucleophilic aromatic substitution	2	Oxaphosphetane intermediate
R	Wittig reaction	3	Meisenheimer complex
S	Friedel-Crafts reaction	4	Anti-Markownikoff's product

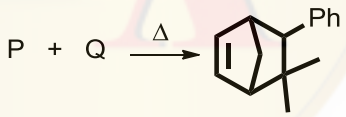
(A) P-2, Q-4, R-1, S-3

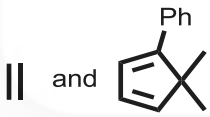
(B) P-4, Q-3, R-1, S-2

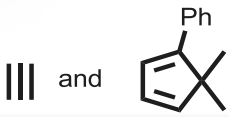
(C) P-4, Q-3, R-2, S-1

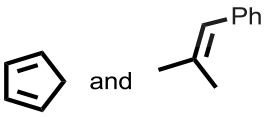
(D) P-2, Q-1, R-4, S-3

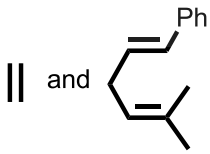
Q.8 The reactants P and Q in the following reaction are



(A) 

(B) 

(C) 

(D) 

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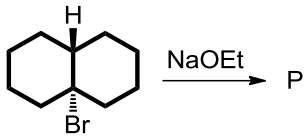
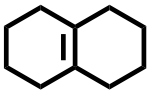
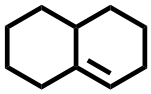
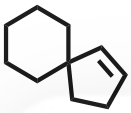
Q.9 The major product formed in the following reaction is

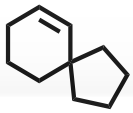


.

(A) 

(B) 

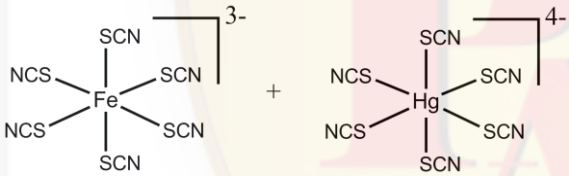
(C) 

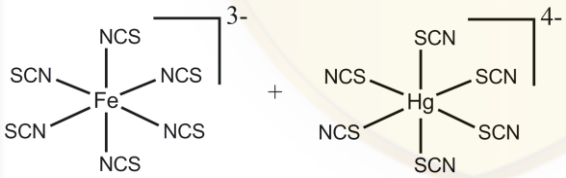
(D) 

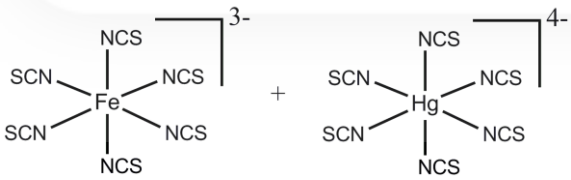
Q.10 The most stable coordination complexes P and Q formed in the following reaction are

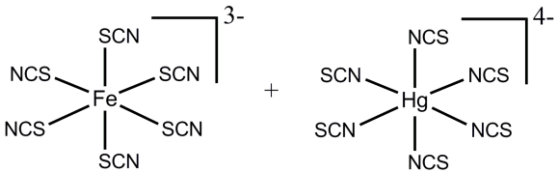
$$Fe^{3+} + Hg^{2+} + SCN^{-} \longrightarrow P + Q$$

.

(A) 

(B) 

(C) 

(D) 

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Q.11 A coordination complex **Y** upon reaction with $AgNO_3$ solution does **NOT** give any precipitation. Complex **Y** possesses two isomers, of which one has zero dipole moment. The crystal field stabilization energy of **Y** is either -0.8 Δ_o or -0.8 Δ_t. The magnetic moment for **Y** is found to be 3.9 Bohr Magneton. The coordination complex **Y** is

(A) $[Ti(NH_3)_4(Cl)_2]$
(B) $[Co(NH_3)_4(H_2O)_2]Cl_2$
(C) $[Co(NH_3)_2(Cl)_2]$
(D) $[Co(NH_3)_4(Cl)_2]$

Q.12 A protein in denatured state (D) is in equilibrium with native state (N).

$$D \rightleftharpoons N$$

At 360 K, both N and D states are equally populated. If the standard entropy change for the reaction at this temperature ΔS^0 = -139 J K^{-1} mol^{-1}, then the corresponding standard enthalpy change ΔH^0 for the reaction in kJ mol^{-1} (**rounded off to one decimal place**) is ____
.

Q.13 The pH of a 1.0 L buffer solution containing 0.2 mol of acetic acid (CH_3COOH) and 0.3 mol of sodium acetate (CH_3COONa) is 5.0. The K_a of acetic acid is P × 10^{-5}, where the numerical value of P (**rounded off to one decimal place**) is ____

Q.14 Based on molecular orbital theory, the number of paramagnetic species in the following list

N_2, N_2^+ , N_2^{2-}, O_2, O_2^+, O_2^- and O_2^{2-}

is ____
(assume that there is no change in energy of the orbitals upon addition/removal of electrons in a molecule)
.

Q.15 Given the standard reduction potentials, $E^0_{Cu^{+2}/Cu} = 0.34$ V and $E^0_{Ag^+/Ag} = 0.80$ V, the standard free energy change (ΔG^0) for the reaction

$Cu\ (s) + 2Ag^+\ (aq) \rightarrow Cu^{+2}\ (aq) + 2Ag\ (s)$

in kJ mol^{-1} (**rounded off to one decimal place;** F= 96500 C mol^{-1}), is ____

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XE-A: Q. 1 – Q. 7 carry one mark each & Q. 8 – Q. 11 carry two marks each.

XE (B to H): Q. 1 – Q. 9 carry one mark each & Q. 10 – Q. 22 carry two marks each.

XL-P: Q. 1 – Q. 5 carry one mark each & Q. 6 – Q. 15 carry two marks each

XL (Q to U): Q. 1 – Q. 10 carry one mark each & Q. 11 – Q. 20 carry two marks each.

Q.1 Catalase is found exclusively in

(A) Lysosomes
(B) Golgi apparatus
(C) Peroxisomes
(D) Mitochondria

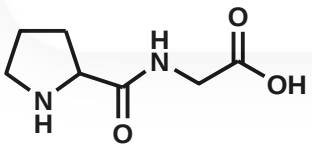
Q.2 RAG recombinase is responsible for the formation of specific immune receptors. This process occurs in

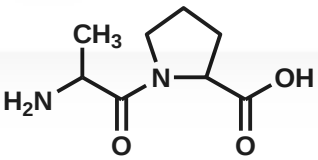
(A) T cells & B cells
(B) Natural killer cells
(C) Macrophages
(D) Neutrophils

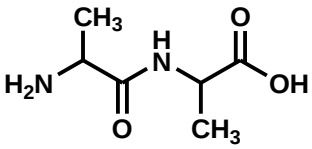
Q.3 The example of substrate level phosphorylation in glycolysis is

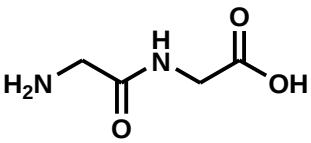
(A) Conversion of Glucose to Glucose-6-phosphate
(B) Conversion of Glyceraldehyde-3-phosphate to 1,3-Bisphosphoglycerate
(C) Conversion of 1,3-Bisphosphoglycerase to 3-Phosphoglycerate
(D) Conversion of Dihydroxyacetone phosphate to Glyceraldehyde-3-phosphate

Q.4 The dipeptide with least rotational barrier in the peptide bond is

A) 

B) 

C) 

D) 

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Q.5 The light-harvesting pigment **NOT** used by Cyanobacteria for photosynthesis is

(A) Rhodopsin
(B) Phycobilin
(C) Phycoerythrobilin
(D) Phycocyanobilin

Q.6 Slow intravenous infusion of ethanol is a therapy to treat methanol poisoning. The underlying chemical reaction is an example of

(A) Competitive inhibition
(B) Non-competitive inhibition
(C) Mixed inhibition
(D) Enzyme activation

Q.7 Nitric oxide synthase is responsible for generation of Nitric oxide, an important signaling molecule. The substrate for this enzyme is

(A) Glycine
(B) Lysine
(C) Histidine
(D) Arginine

Q.8 Allergies are due to a hyper immune response. Drugs given to counter allergies target

(A) Glycine
(B) Histamine
(C) Insulin
(D) Cellulose

Q.9 The electrostatic interaction energy between a positively charged atom A and negatively charged atom B separated by 3 Å in water is -6 kJ/mol. Considering the relative permittivity of water to be 80, the electrostatic interaction energy in kJ/mol (rounded off to one decimal place) between atoms A and B in vacuum is _____.

Q.10 You are given a 0.1M solution of Glucose (stock solution). The stock solution required to make 0.5 ml of 0.005M Glucose solution (rounded off to three decimal places) in ml is _____.

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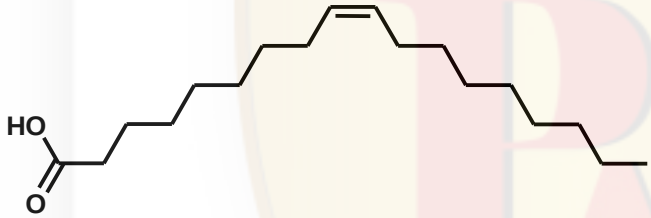
Q.11 A mixture of the following purified proteins, IgG, IgM and Fab fragment of immunoglobulins, is separated using gel filtration chromatography. The order of elution of these proteins (first to last) is

(A) Fab fragment, IgM and IgG
(B) IgM, IgG and Fab fragment
(C) Fab fragment, IgG and IgM
(D) IgG, IgM and Fab fragment

Q.12 The ascending order of half-life for the radioactive isotopes, ^{125}I, ^{3}H, ^{14}C and ^{32}P, is

(A) $^{14}C < ^{125}I < ^{3}H < ^{32}P$
(B) $^{32}P < ^{3}H < ^{125}I < ^{14}C$
(C) $^{14}C < ^{3}H < ^{32}P < ^{125}I$
(D) $^{32}P < ^{125}I < ^{3}H < ^{14}C$

Q.13 The enzyme **NOT** involved in oxidation of the molecule shown below is



(A) Δ^3, Δ^2 - Enoyl –CoA isomerase
(B) Propionyl-CoA caboxylase
(C) Acyl CoA dehydrogenase
(D) Enoyl CoA hydratase

Q.14 DpnI is used to digest the PCR product during site directed mutagenesis because

(A) DpnI digests irrespective of methylation status of DNA
(B) DpnI digests only unmethylated DNA
(C) DpnI digests only methylated DNA
(D) DpnI digests GC-rich sequences

Q.15 Which one of the following is an **incorrect** biomolecule-modification pair?

(A) Lipid - Palmitoylation
(B) DNA and Protein - Methylation
(C) Protein - Glycosylation
(D) RNA - Polyadenylation

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Q.16 The crystal structure of a peptide has an ordered structural repeat of amino acids with a distance of ~ 6.5 Å between the alternate C_α atoms. Which one of the following pair of dihedral angles (Φ and Ψ) accurately represents the peptide structure?

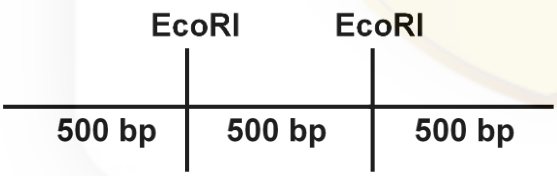
(A) $\Phi \approx -60°$, $\Psi \approx -50°$
(B) $\Phi \approx -120°$, $\Psi \approx -50°$
(C) $\Phi \approx -60°$, $\Psi \approx +120°$
(D) $\Phi \approx -120°$, $\Psi \approx +120°$

Q.17 Absence of detectable protein expression upon blunt-ended mutation-free cloning of an *E.coli* gene with its own promoter in *E. coli* cells can be due to

(A) Cloning occurred in reverse orientation
(B) Cloning occurred out of frame
(C) Codon bias
(D) Rapid degradation of expressed protein

Q.18 The C-terminal carboxyl group and the N-terminal amino group in amino acids have a dissociation constant (pK_a) of 2.2 and 9.2, respectively. The pK_a of side chain carboxyl group in glutamic acid is 4.2 and side chain amino group in lysine is 10.2. The difference in isoelectric point (pI) of lysine and glutamic acid (rounded off to two decimal places) is ____.

Q.19 X different sized DNA fragments can be observed upon incomplete EcoRI digestion of identical DNA molecules with two EcoRI sites as shown below. The maximum value of X is _____.



Q.20 An uncharged protein (P) has an Asp in position 23 with a molecular weight of 6501 Da, as determined by mass spectrometry. The uncharged mutant of this protein (P') contains a single amino acid substitution with Asn at position 23. The molecular weight of P', as determined by mass spectrometry (rounded off to one decimal place) is ____Da.

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XL-R: Q. 1 – Q. 10 carry one mark each

Q.1 Which one of the following ecosystems is represented by an inverted pyramid of numbers?

(A) Grassland
(B) Pond
(C) Desert
(D) Parasitic forest

Q.2 Raphides are deposits of

(A) calcium oxalate
(B) calcium carbonate
(C) silica bodies
(D) protein bodies

Q.3 Which one of the following families shows bicollateral vascular bundle in the transverse section of the stem?

(A) Rutaceae
(B) Asteraceae
(C) Cucurbitaceae
(D) Malvaceae

Q.4 Arbuscules are highly branched structures, formed by

(A) ectomycorrhizae
(B) endomycorrhizae
(C) arbutoid mycorrhizae
(D) monotropoid mycorrhizae

Q.5 Which one of the following combinations of polysaccharides is present in plant cell wall?

(A) Only cellulose, hemicellulose and fibroin
(B) Only cellulose, hemicellulose and lignin
(C) Only cellulose, hemicellulose and pectin
(D) Only cellulose, pectin and lignin

Q.6 Which one of the following statements is **INCORRECT**?

(A) Nitrogen fixation is aerobic process
(B) Dinitrogenase catalyzes reduction of nitrogen to ammonia
(C) Root nodules are found in *Glycine max*
(D) Nitrogen fixation is anaerobic process

Q.7 Which one of the following statements is **INCORRECT** with respect to cyclic photophosphorylation?

(A) ATP is generated without concomitant formation of NADPH
(B) Electron flows from Photosystem I to cytochrome *bf* complex
(C) Photosystem II does not participate in cyclic photophosphorylation
(D) Cyclic photophosphorylation occurs when $NADP^+$/NADPH ratio is high

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Q.8 The plant cells are considered totipotent. The phenomenon of a mature cell reverting to the meristematic state and forming undifferentiated callus tissue is called

(A) redifferentiation
(B) dedifferentiation
(C) organogenesis
(D) recalcitrancy

Q.9 Glyphosate is a broad spectrum herbicide. Upon application to leaves, it is translocated to meristematic areas and underground rhizomes by

(A) phloem
(B) xylem
(C) border pits
(D) tracheids

Q.10 If a species has 2n = 16 chromosomes, the number of chromosomes per cell in a double monosomic individual would be_____

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Q. 11 – Q. 20 carry two marks each.

Q.11 Rubisco catalyzes conversion of ribulose 1,5-bisphosphate to

P. two molecules of stable 3-phosphoglycerate
Q. one molecule of 3-phosphoglycerate and one molecule of phosphoglycolate
R. one molecule of ribulose 5-phosphophate
S. one molecule of ribose 5-phosphate

Choose only the correct combination

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

Q.12 Select correct combination of molecules given in **Group I** with their functions in **Group II**

Group I	**Group II**
P. Ubiquitin	1. Cell wall loosening enzymes
Q. Phytotropins	2. Repressors in gibberellin signaling
R. Extensins	3. Mediator of protein degradation
S. DELLA proteins	4. Noncompetitive inhibitors of polar transport of auxin

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

Q.13 Match the plant species and their corresponding families with their economically important products:

Plant species	**Family**	**Plant product**
P. *Cannabis sativa*	1. Lamiaceae	i. Oil from seeds
Q. *Corchorus olitorius*	2. Cannabaceae	ii. Eugenol from leaves
R. *Ocimum sanctum*	3. Euphorbiaceae	iii. Fibre from stem
S. *Ricinus communis*	4. Tiliaceae	iv. Marijuana from leaves

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

Q.14 Cybrids may arise through the

(A) fusion of a normal protoplast with another nucleated protoplast of different origin

(B) fusion between a normal protoplast and a protoplast containing viable nucleus

(C) elimination of one of the nuclei from heterokaryon formed from two protoplasts of different origin

(D) fusion of a normal cell with another nucleated cell

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Q.15 Match the disease with causative organism and affected crop

Disease	Causative organism	Crop
P. Powdery mildew	1. *Albugo candida*	i. Corn
Q. White rust	2. *Phytophthora infestans*	ii. Tomato
R. Downy mildew	3. *Erysiphe orontii*	iii. Potato
S. Late blight	4. *Peronoscleropora phillippinensis*	iv. Mustard

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

Q.16 Match the options in **Group I** with that of **Group II** with respect to steps in signal transduction mechanism in plants

Group I	Group II
P. Phospholipase C	1. stimulates release of calcium from intracellular stores
Q. Inositol triphosphate	2. regulates ion channels/activates various enzymes
R. Diacylglycerol	3. hydrolyzes posphatidylinositol bisphosphate (PIP2)
S. Phosphatidic acid	4. phosphorylated to phosphatidic acid

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

Q.17 Which one of the following statements is **CORRECT** with respect to endosperm development? It originates

(A) from the fusion product of three haploid nuclei - one from male gametophyte and two from the female gametophyte
(B) from the fusion product of three haploid nuclei - two from male gametophyte and one from the female gametophyte
(C) from the fusion product of two haploid nuclei - one from male gametophyte and one from the female gametophyte
(D) by a phenomenon called apomixis

Q.18 Which one of the following methods is **INCORRECT** with respect to haploid plant production? It can be produced

(A) from an unfertilized egg cell
(B) from nucellar tissue
(C) from isolated pollen culture
(D) by distant hybridization, followed by selective elimination of chromosomes of one of the parents

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Q.19 Plant weight is determined by a pair of alleles at each of the two independently assorting loci (**Aa** and **Bb**) that are additive and equal in their effects. The recessive alleles do not contribute towards plant weight. Plants with genotype **aa bb** are 1 g in weight, whereas plants with genotype **AA BB** weigh 3.4 g. Plant with genotype **aa bb** is crossed with a plant of genotype **AA BB**. The weight (in g, round off to one decimal place) of an individual plant in F_1 progeny of this cross would be_____

Q.20 A cell in G_1 of Interphase has 12 chromosomes. In Anaphase-I of meiosis, the number of DNA molecules per cell will be_____

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XL-S: Q. 1 – Q. 10 carry one mark each & Q. 11 – Q. 20 carry two marks each.

Q.1 Chloramphenicol and tetracycline are broad spectrum antibiotics which inhibit bacterial growth by targeting _____.

(A) cell wall synthesis
(B) protein synthesis
(C) RNA synthesis
(D) DNA synthesis

Q.2 Which of the following radiation methods is used in preserving food from spoilage by microorganisms?

(A) Radio waves
(B) Microwaves
(C) Non-ionizing
(D) Ionizing

Q.3 Which part of the lipopolysaccharides has toxic properties that make some bacterial infections a potentially serious medical problem?

(A) Polysaccharide side-chains
(B) Lipid A portion
(C) Repeat carbohydrate units
(D) Core region of polysaccharides

Q.4 Microbes make up about _____ of earth's living material by weight.

(A) $1/4^{th}$
(B) $2/3^{rd}$
(C) $3/4^{th}$
(D) $4/5^{th}$

Q.5 The highly contagious viral disease measles is caused by a

(A) double-stranded DNA virus
(B) single-stranded DNA virus
(C) single-stranded RNA virus
(D) double-stranded RNA virus

Q.6 Secondary metabolites such as penicillin from mold are produced during the _____ .

(A) lag phase
(B) idiophase
(C) log phase
(D) decline phase

Q.7 Dick test is used to assess the susceptibility to_____ .

(A) diphtheria
(B) scarlet fever
(C) typhoid fever
(D) tuberculosis

Q.8 Which of the following is a symbiotic bacterial genus that converts nitrogen into nitrogen containing compounds that are utilized by legume plants to synthesize amino acids?

(A) *Spirillum*
(B) *Azotobacter*
(C) *Rhizobium*
(D) *Clostridium*

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Q.9 What is the enzyme involved in the following reaction?
Triglyceride + $3H_2O$ ⟶ Glycerol + fatty acids

(A) Glycerol phosphate dehydrogenase
(B) Glycerol kinase
(C) Lipase
(D) Zymase

Q.10 A bacterial culture contains 500 organisms / mL in the exponential growth phase at 8 am in the morning. If you consider a generation time of 20 minutes, the total number of organisms / mL (round off to the nearest integer) after three hours (i.e. at 11 am in the morning) will be _____.

Q.11 Folic acid synthesis in bacteria is competitively inhibited by sulfonamides. Which of the following essential components is replaced by sulfonamides during the process of folic acid synthesis?

(A) Pteridine
(B) Glutamic acid
(C) Para-amino benzoic acid
(D) Sulfamethaxazole

Q.12 Which of the following cellular structures are absent in eukaryotes and are present at least in some prokaryotic organisms?

(i) Respiratory enzymes
(ii) Ribosomes
(iii) Nucleoid
(iv) Internal membranes
(v) Pili

(A) (iii) and (v)
(B) (i) and (iv)
(C) (i), (iii) and (v)
(D) (iii), (iv)

Q.13 Granules are inclusion bodies found in bacteria. Which of the following statements are true about granules?

(i) Granules can be storage vessels for carbohydrates/lipids
(ii) Some granules supply substances for a variety of metabolic processes
(iii) Granules are dissolved in cytoplasm
(iv) Granules are membrane-enclosed structures

(A) (ii) and (iii)
(B) (iii) and (iv)
(C) (i) and (ii)
(D) (i) and (iii)

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Q.14 Match the culture media to their uses

Culture Media	Uses
(i) Complex media	(p) identifying certain bacteria from mixed culture
(ii) Selective media	(q) chemically undefined media for growing bacteria
(iii) Differential media	(r) cultivating fastidious bacteria
(iv) Enriched media	(s) distinguishing one bacteria from another

(A) (i)-(s), (ii)-(r), (iii)-(q), (iv)-(p)
(B) (i)-(q), (ii)-(p), (iii)-(s), (iv)-(r)
(C) (i)-(q), (ii)-(r), (iii)-(p), (iv)-(s)
(D) (i)-(p), (ii)-(s), (iii)-(q), (iv)-(r)

Q.15 Among the following characteristics listed below, select those that are the most appropriate for archaebacteria.

(i) Peptidoglycan containing muramic acid and D-amino acids are present in cell wall
(ii) Long chain branched alcohols (phytanols) bound to glycerol by ether linkages are found in the lipids of cytoplasmic membrane
(iii) First amino acid to initiate new polypeptide chain is N-Formylmethionine
(iv) Translation process is sensitive to the action of diphtheria toxin

(A) (i), (iii)
(B) (ii), (iii), (iv)
(C) (ii), (iv)
(D) (i), (ii), (iv)

Q.16 Which of the following processes are involved in horizontal gene transfer (HGT)?

(i) Conjugation
(ii) Transduction
(iii) Binary fission
(iv) Transformation
(v) Translesion synthesis
(vi) Transversion

(A) (i), (iii), (iv)
(B) (i), (iv), (vi)
(C) (ii), (iv), (v)
(D) (i), (ii), (iv)

Q.17 Match the class of antibodies to appropriate description or function

Antibodies	Description / function
(i) IgA	(p) Mucosal immunity
(ii) IgG	(q) Immunity to parasitic infections
(iii) IgD	(r) Most abundant antibody in the blood
(iv) IgE	(s) Found on the B cell membranes

(A) (i)-(s), (ii)-(r), (iii)-(q), (iv)-(p)
(B) (i)-(p), (ii)-(q), (iii)-(s), (iv)-(r)
(C) (i)-(p), (ii)-(r), (iii)-(s), (iv)-(q)
(D) (i)-(p), (ii)-(s), (iii)-(q), (iv)-(r)

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Q.18 Match the diseases with the appropriate causative agents

Disease	Causative agent
(i) Rheumatic heart disease	(p) *Candida albicans*
(ii) Syphilis	(q) Group A *Streptococcus*
(iii) Genital warts	(r) Human papilloma virus
(iv) Oral thrush	(s) *Treponema pallidum*

(A) (i)-(p), (ii)-(q), (iii) –(s), (iv)-(r)
(B) (i)- (q), (ii)- (s), (iii)-(r), (iv)-(p)
(C) (i)-(r), (ii)-(s), (iii)-(p), (iv)-(q)
(D) (i)-(s), (ii)-(q), (iii)- (p), (iv) –(r)

Q.19 Consider a spherical bacterial cell with diameter 2 µm and a eukaryotic cell of spherical shape with a diameter of 20 µm. The surface area to volume (in μm^{-1}) ratio of the bacterial cell (round off to 1 decimal place) is _____ times more than that of the eukaryotic cell.

Q.20 When grouping bacteria using numerical taxonomy approach, many characteristics are determined for each strain. If all characteristics are same, then the % similarity is 100. When comparing two bacterial strains, if 72 characteristics are the same and 44 characteristics are different, the % similarity (round off to 2 decimal places) between the two strains is _____.

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XL-T: Q. 1 – Q. 10 carry one mark each & Q. 11 – Q. 20 carry two marks each.

Q.1 Which one of the following animals possesses two chambered heart?

(A) Chameleon (B) Peacock (C) Gold fish (D) Blue whale

Q.2 In eukaryotic chromatin organization, which one of the histones seals off the nucleosome at the location at which linker DNA enters and leaves the nucleosome?

(A) H1 (B) H2A-H2B (C) H3 (D) H4

Q.3 Which one of the following parasites does NOT cause lymphatic filariasis?

(A) *Brugia malayi* (B) *Brugia timori*
(C) *Wuchereria bancrofti* (D) *Mansonella streptocerca*

Q.4 A species adapted to a specific habitat is called

(A) Biome (B) Ecotone
(C) Ecotype (D) Niche

Q.5 The phylum that is characterized by the animals having a "water vascular system" is

(A) Cnidaria (B) Annelida
(C) Mollusca (D) Echinodermeta

Q.6 The finches on the Galapagos Islands have widely differing beaks adapted according to their diets. This is an example of

(A) Adaptive radiation (B) Parallel evolution
(C) Adaptive convergence (D) Co-adaptation

Q.7 Which one of the following animals is named as a "living fossil", where the animal is persisting above 400 million years without further major morphological evolution?

(A) King crabs (B) Porcelain crabs (C) Horseshoe crabs (D) Hermit crabs

Q.8 Consider the given peptide, Ala-Glu-Val-Asn-Ile-Asp-Pro-Asp-Gln-Gly-Asp. The net charge on the peptide at pH 1.0 will be____

Q.9 The total number of complementary determining regions (CDRs) in the functional form of an IgM antibody is _____

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Q.10 In a 1500 base pair double stranded B-DNA, 70% of purines are adenine bases. The total number of hydrogen bonds (Watson–Crick base pairing) in the DNA will be _____

Q.11 Match the given vitamins in **Column I** with the related proteins in **Column II**

Column I	**Column II**
a) Vitamin C	1) Thrombin
b) Vitamin K	2) Rhodopsin
c) Vitamin A	3) Pyruvate dehydrogenase
d) Vitamin B_1	4) Prolyl hydroxylase

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

Q.12 Match the following terms in **Column I** with the appropriate explanation in **Column II**

Column I	**Column II**
a) Spliceosome	1) Cell scavengers
b) Peroxisome	2) Metabolism of long chain fatty acids
c) Lysosome	3) Microtubules
d) Centrosome	4) Post transcriptional modifications

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

Q.13 Match the respective behaviour given in **Column I** with the appropriate explanation in **Column II**

Column I	**Column II**
a) Agonistic behaviour	1) Individual behaviour where fitness of other increases at the expense of self
b) Hierarchical behaviour	2) Individuals contribute towards enhancement of mutual fitness
c) Altruistic behaviour	3) Aggressive behaviour of individuals within a population
d) Cooperative behaviour	4) Existence of different levels of dominance within a population

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

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Q.14 Closure of neural tube during neurulation is the process in which neural tube eventually forms a closed cylinder that separates from surface ectoderm. Which one of the following terms is linked to the failure in the closure of entire neural tube i.e. brain and spinal cord, over the body axis?

(A) Craniorachischisis
(B) Spina bifida
(C) Anencephaly
(D) Cleft palate

Q.15 Which one of the following factors does NOT contribute to "allopatric speciation"?

(A) The isolated population is exposed to different selection pressure as compared to parent population
(B) A population become geographically isolated from the parent population
(C) There is a gene flow between the two separated populations
(D) Genetic drift occurs between the two separated populations

Q.16 Match the hormones in **Column I** to their respective physiological effects in **Column II**

Column I	**Column II**
a) Melatonin	1) Inhibition of secretion of growth hormone
b) Oxytocin	2) Synthesis of milk in mammary gland
c) Cholecystokinin	3) Secretion of milk and uterine contraction
d) Prolactin	4) Secretion of enzymes from pancreatic acinar cells
e) Somatostatin	5) Regulation of circadian rhythms

(A) a-5; b-4; c-2; d-3; e-1
(B) a-3; b-5; c-4; d-2; e-1
(C) a-5; b-1; c-2; d-3; e-4
(D) a-5; b-3; c-4; d-2; e-1

Q.17 The molecular weight of a double stranded DNA fragment present in mitochondria is 7.92×10^8 g mol^{-1}. A pair of nucleotide contributes 0.34 nm to the length of DNA and the average molecular weight of a nucleotide is 330 g mol^{-1}. The number of protein molecules, consisting of 200 amino acids each, coded by this mitochondrial DNA is _____

Q.18 An enzyme that follows Michaelis-Menten kinetics catalyzes the conversion of 35 μM substrate into product with a reaction velocity of 10 μM s^{-1}. The K_m and k_{cat} for the substrate are 14 μM and 500 s^{-1} respectively. The total amount of enzyme taken for the enzyme reaction is _____nM.

Q.19 A distinctly large population of randomly mating laboratory mice contains 36% albino mice, which is caused by a double recessive genotype (aa). The black coloured mice in the population is due to dominant genotype (AA/Aa). Considering the fact that this population is in Hardy-Weinberg equilibrium, the frequency of heterozygous alleles (Aa) in this population is _____ **(*round off to 2 decimal places*)**.

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Q.20 A genetic cross was made between homozygous wild-type males ($a^+a^+b^+b^+c^+c^+$) and triple-mutant females (aabbcc) of *Drosophila melanogaster*. Then the F_1 males ($a^+ab^+bc^+c$) were back crossed to the triple-mutant females which resulted in the following F_2 progenies:

a^+bc	16
ab^+c	115
abc	311
a^+b^+c	64
abc^+	61
$a^+b^+c^+$	317
a^+bc^+	99
ab^+c^+	17
Total	= 1000

The order of genes as determined from the above data was found to be "b a c" (*note that the order is equivalent to "c a b" and the order of outside makers are arbitrary*).

The map distance between "b and c" is _____ centiMorgan ***(round off to 1 decimal place)***.

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Q. 1 – Q. 10 carry one mark each & Q. 11 – Q. 20 carry two marks each.

Q.1 Colloidal stability of milk casein is because of the highly hydrated carbohydrate residues in _____.

(A) α_{s1} casein (B) α_{s2} casein (C) β casein (D) κ casein

Q.2 Rice bran is stabilized prior to oil extraction to protect it from the activity of _____.

(A) Polyphenol oxidase
(B) Peroxidase
(C) Lipase
(D) Lipoxygenase

Q.3 Sticking of powder to wall of the chamber during spray drying of fruit juice is due to ____.

(A) Low glass transition temperature of the compounds in juice
(B) High glass transition temperature of the compounds in juice
(C) Improper processing parameters of spray dryer
(D) Presence of gums in feed material

Q.4 Thearubigins and theaflavins in black tea are formed by the oxidation and dimerization of _____.

(A) Quercetin (B) Catechins (C) Gallic acid (D) Kaempferol

Q.5 Ratio of Schmidt number to Lewis number is _____.

(A) Prandtl number
(B) Reynolds number
(C) Nusselt number
(D) Sherwood number

Q.6 'Red dog' is one of the byproducts during milling of _____.

(A) Corn (B) Rice (C) *Ragi* (D) Wheat

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Q.7 a) **Assertion**: Ash content is one of the quality indicators of the flour to be used for bread making.
r) **Reason**: Higher ash content indicates better quality of the bread flour.

Choose the correct answer from the following:

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

Q.8 An ice cream mix of 870 g L^{-1} has been used to prepare ice cream which yielded a finished product of 490 g L^{-1}. The per cent over run is _____ (*round off to 1 decimal place*).

Q.9 Impeller in a fruit juice mixing tank is rotating at 200 rpm with a Reynolds number $>10^4$. Density of juice is 1045 kg m^{-3}. If diameter of the impeller is doubled and other conditions remained constant, the power requirement of mixing will increase by a factor of _____.

Q.10 Paddy consisting of 20% husk has been milled to remove 6% bran during polishing. Assuming no other losses, yield (per cent) of polished rice from the paddy is _____ (*round off to 1 decimal place*).

Q.11 Match the following laws in Column I with corresponding phenomenon in Column II.

	Column I		**Column II**
P	Newton's law	1	Size reduction
Q	Hertz constant stress theory	2	Substance cooling
R	Fick's law	3	Damage of fruits and vegetables
S	Bond's law	4	Molecular diffusion

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

Q.12 Match the mold in Column I with its asexual/sexual spore shown in Column II.

	Column I		**Column II**
P	*Aspergillus*	1	Arthrospore
Q	*Geotrichum*	2	Oospores
R	*Rhizopus*	3	Conidia
S	*Oomycetes*	4	Sporangiospores

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

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Q.13 Match the foods given in Column I with their specific usage given in Column II.

	Column I		Column II
P	Egg yolk	1	Ice cream
Q	Pregelatinised starch	2	Mayonnaise
R	Gum	3	Baking powder
S	Starch	4	Baby food

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

Q.14 Match the bioactive compounds in Column I with their botanical source given in Column II.

	Column I		Column II
P	Isoflavones	1	Corn
Q	Resistant starch	2	Grapes
R	Xanthophyll	3	Soybean
S	Resveratrol	4	Plantain (culinary banana)

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

Q.15 Match the following microbial species in Column I with related disease caused by them as shown in Column II.

	Column I		Column II
P	*Vibrio sp.*	1	Gastroenteritis
Q	*Shigella sp.*	2	Typhoid
R	*E. coli*	3	Cholera
S	*Salmonella typhi*	4	Bacillary dysentery

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

Q.16 Buffalo milk having density of 1030 kg m^{-3} is homogenized with a pressure of 30 MPa. Given, acceleration due to gravity as 9.81 m s^{-2} and assuming no pressure loss, the velocity (m s^{-1}) of the milk flowing through the homogenizer valve will be _____ (*round off to 2 decimal places*).

Q.17 Potato slices have been dehydrated from an initial solid content of 12% to a final solid content of 94%. If the peeling and other losses are to the tune of 10%, final yield (per cent) of the dried chips per ton of fresh potato taken is _____ (*round off to 2 decimal places*).

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Q.18 A mixed fruit beverage with 12 °Brix having specifc heat of 4298 J kg^{-1} K^{-1} is being heated from 30 °C to 95 °C for pasteurization at a flow rate of 1000 L h^{-1} in a tubular heat exchanger. Steam at 100 °C is used as heating medium which is converted into condensate at 100 °C. If the density of beverage is 1075 kg m^{-3} and the latent heat of steam at the given temeparture is 2257 kJ kg^{-1}, the mass flow rate of steam (kg min^{-1}) is _____ (*round off to 2 decimal places*).

Q.19 Room air is at 40 °C with 60% relative humidity. Saturated vapour pressure of water at 40 °C is 7.375 kPa. Humid volume of air (m^3 per kg of dry air) is _____ (*round off to 3 decimal places*).

Q.20 Freezing of 100 mm spherical meat ball with 60% moisture at 35 °C is being done in an air blast freezer maintained at -45 °C. Given, latent heat of fusion for water is 333.2 kJ kg^{-1}, thermal conductivity of meat is 1.5 W m^{-1} $°C^{-1}$, convective heat transfer coefficient is 40 W m^{-2} $°C^{-1}$, density of frozen meat is 980 kg m^{-3} and initial freezing temperature of meat ball is -10 °C. Using Plank's equation, freezing time (h) is _____ (*round off to 2 decimal places*).

END OF THE QUESTION PAPER

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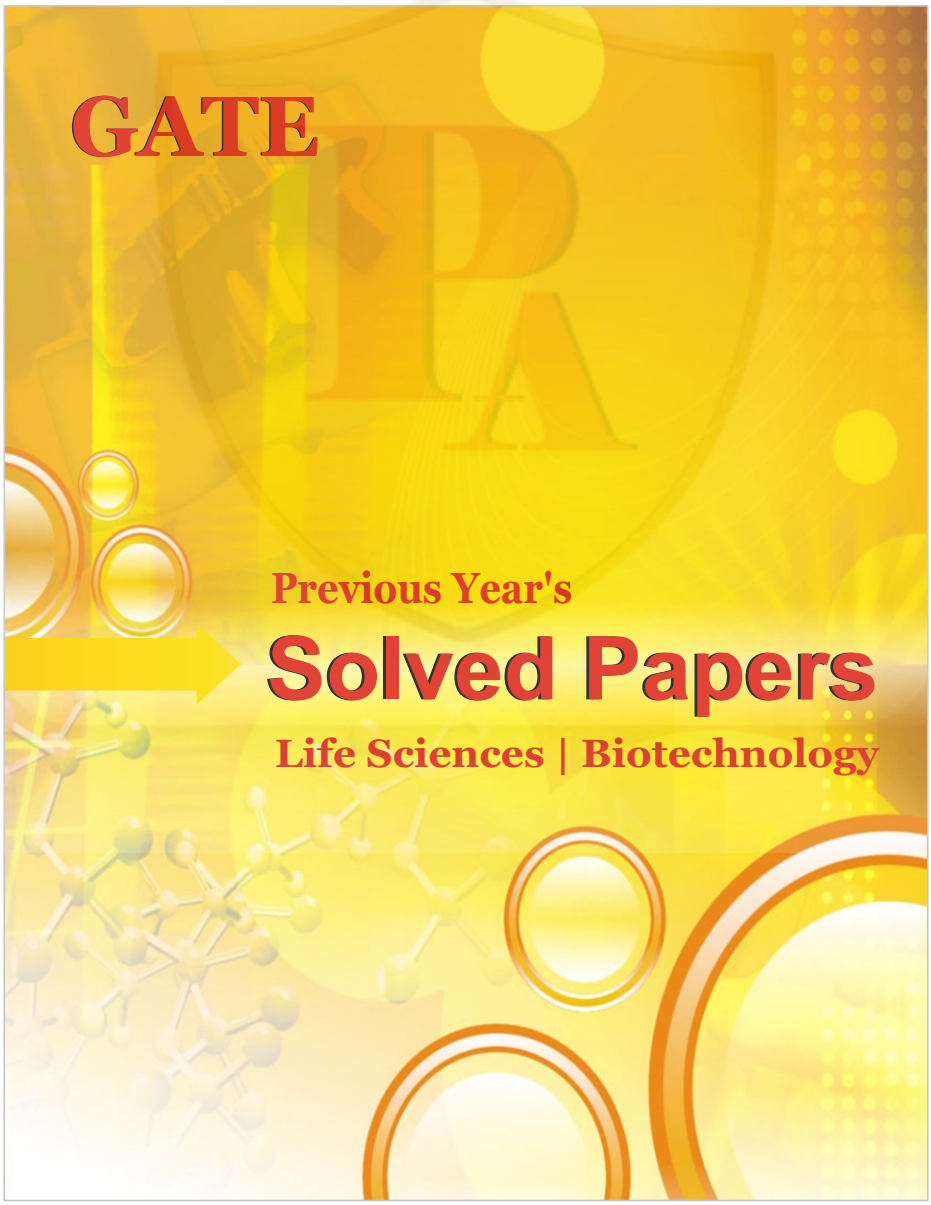

Q.No.	Type	Section	Key	Marks
1	MCQ	GA	B	1
2	MCQ	GA	A	1
3	MCQ	GA	B	1
4	MCQ	GA	Mark to All	1
5	MCQ	GA	D	1
6	MCQ	GA	A	2
7	MCQ	GA	B	2
8	MCQ	GA	B	2
9	MCQ	GA	B	2
10	MCQ	GA	A	2
1	MCQ	XL-P	C	1
2	MCQ	XL-P	D	1
3	MCQ	XL-P	D	1
4	NAT	XL-P	3 to 3	1
5	NAT	XL-P	2 to 2	1
6	MCQ	XL-P	D	2
7	MCQ	XL-P	C	2
8	MCQ	XL-P	C	2
9	MCQ	XL-P	A	2
10	MCQ	XL-P	B	2
11	MCQ	XL-P	D	2
12	NAT	XL-P	-51.0 to -49.0	2
13	NAT	XL-P	1.4 to 1.6	2

Q.No.	Type	Section	Key	Marks
14	NAT	XL-P	5 to 5	2
15	NAT	XL-P	-89.8 to -87.8	2
1	MCQ	XL-Q	C	1
2	MCQ	XL-Q	A	1
3	MCQ	XL-Q	C	1
4	MCQ	XL-Q	B	1
5	MCQ	XL-Q	A	1
6	MCQ	XL-Q	A	1
7	MCQ	XL-Q	D	1
8	MCQ	XL-Q	B	1
9	NAT	XL-Q	-480.1 to -479.9	1
10	NAT	XL-Q	0.024 to 0.026	1
11	MCQ	XL-Q	B	2
12	MCQ	XL-Q	D	2
13	MCQ	XL-Q	B	2
14	MCQ	XL-Q	C	2
15	MCQ	XL-Q	A	2
16	MCQ	XL-Q	D	2
17	MCQ	XL-Q	D	2
18	NAT	XL-Q	6.49 to 6.51	2
19	NAT	XL-Q	3 to 3	2
20	NAT	XL-Q	6499.9 to 6500.1	2
1	MCQ	XL-R	D	1

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Q.No.	Type	Section	Key	Marks
2	MCQ	XL-R	A	1
3	MCQ	XL-R	C	1
4	MCQ	XL-R	B	1
5	MCQ	XL-R	C	1
6	MCQ	XL-R	A	1
7	MCQ	XL-R	D	1
8	MCQ	XL-R	B	1
9	MCQ	XL-R	A	1
10	NAT	XL-R	14 to 14	1
11	MCQ	XL-R	C	2
12	MCQ	XL-R	A	2
13	MCQ	XL-R	D	2
14	MCQ	XL-R	C	2
15	MCQ	XL-R	B	2
16	MCQ	XL-R	D	2
17	MCQ	XL-R	A	2
18	MCQ	XL-R	B	2
19	NAT	XL-R	2.2 to 2.2	2
20	NAT	XL-R	24 to 24	2
1	MCQ	XL-S	B	1
2	MCQ	XL-S	D	1
3	MCQ	XL-S	B	1
4	MCQ	XL-S	B	1

Q.No.	Type	Section	Key	Marks
5	MCQ	XL-S	C	1
6	MCQ	XL-S	B	1
7	MCQ	XL-S	B	1
8	MCQ	XL-S	C	1
9	MCQ	XL-S	C	1
10	NAT	XL-S	255999 to 256001	1
11	MCQ	XL-S	C	2
12	MCQ	XL-S	A	2
13	MCQ	XL-S	C	2
14	MCQ	XL-S	B	2
15	MCQ	XL-S	C	2
16	MCQ	XL-S	D	2
17	MCQ	XL-S	C	2
18	MCQ	XL-S	B	2
19	NAT	XL-S	9.9 to 10.1	2
20	NAT	XL-S	61.50 to 62.50	2
1	MCQ	XL-T	C	1
2	MCQ	XL-T	A	1
3	MCQ	XL-T	D	1
4	MCQ	XL-T	C	1
5	MCQ	XL-T	D	1
6	MCQ	XL-T	A	1
7	MCQ	XL-T	C	1

Q.No.	Type	Section	Key	Marks
8	NAT	XL-T	1 to 1	1
9	NAT	XL-T	60 to 60	1
10	NAT	XL-T	3450 to 3450	1
11	MCQ	XL-T	A	2
12	MCQ	XL-T	B	2
13	MCQ	XL-T	B	2
14	MCQ	XL-T	A	2
15	MCQ	XL-T	C	2
16	MCQ	XL-T	D	2
17	NAT	XL-T	1900 to 2000 OR 3900 to 4000	2
18	NAT	XL-T	28 to 28	2
19	NAT	XL-T	0.48 to 0.48	2
20	NAT	XL-T	40.5 to 40.5	2
1	MCQ	XL-U	D	1
2	MCQ	XL-U	C	1
3	MCQ	XL-U	A	1
4	MCQ	XL-U	B	1
5	MCQ	XL-U	A	1
6	MCQ	XL-U	D	1
7	MCQ	XL-U	D	1
8	NAT	XL-U	77.4 to 77.6	1
9	NAT	XL-U	32 to 32	1
10	NAT	XL-U	74.8 to 75.6	1

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Q.No.	Type	Section	Key	Marks
11	MCQ	XL-U	A	2
12	MCQ	XL-U	A	2
13	MCQ	XL-U	A	2
14	MCQ	XL-U	B	2
15	MCQ	XL-U	D	2
16	NAT	XL-U	240.00 to 242.00	2
17	NAT	XL-U	11.45 to 11.55	2
18	NAT	XL-U	2.16 to 2.25	2
19	NAT	XL-U	0.924 to 0.930	2
20	NAT	XL-U	1.06 to 1.09	2

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