Q. 1 – Q. 25 carry one mark each.

Q.1   Under alkaline conditions, DNA is more stable than RNA because

(A) RNA forms secondary structures

(B) RNA is a single stranded molecule

(C) RNA has uracil in place of thymidine

(D) RNA is susceptible to hydrolysis

Q.2   Which one of the following modifications is common toboth protein and DNA?

(A) SUMOylation   (B) Nitrosylation   (C) Methylation   (D) Ubiquitination

Q.3   Protein A, which has strong affinity to Fc region of immunoglobulin, is extracted from

(A) Saccharomyces cerevisiae   (B) Staphylococcus aureus

(C) Streptococcus pyogenes   (D) Streptococcus sanguis

Q.4   The first humanized monoclonal antibody approved for the treatment of breast canceris

(A) Rituximab   (B) Cetuximab   (C) Bevacizumab   (D)   Herceptin

Q.5   Which one of the following aminoacids in proteins does **NOT** undergo phosphorylation?

(A) Ser   (B) Thr   (C) Pro   (D)   Tyr

Q6.   The role of an aduvant isto

(A) prolong the persistence of antigen

(B) cross link the antigen

(C) increase the size of antigen

(D) avoid inflammation

Q7.   Endogenous antigens are presented on to the cell surface along with

(A) MHC-II   (B) MHC-I   (C) Fcγreceptor   (D) complement receptor

Q.8   Human genome sequencing project involved the construction of genomic library in

(A) Bacterial artificial chromosome   (B) pBR322

(C) Bacteriophage   (D) pcDNA3.1

Q.9   The nucleotide analogue used in DNA sequencing by chain termination method is

(A) 1',3'-dideoxy nucleoside triphosphate

(B) 2',3'-dideoxy nucleoside triphosphate

(C) 2',4'-dideoxy nucleoside triphosphate

(D) 2',5'-dideoxy nucleoside triphosphate

Q.10   In nature, the horizontal gene transfer across bacteria is mediated by

(A) Gene cloning followed by transformation

(B) Conjugation and transformation

(C) Conjugation only

(D) Transformation only

Q.11 Phylum proteobacteria is subdivided into $\alpha-, \beta-, \gamma-, \delta-$ and $\varepsilon-$ proteobacteria based on

(A) G+C content
(B) 23S rRNA sequences
(C) tRNA sequences
(D) 16S rRNA sequences

Q12. Which of the following in an ABC transporter?
(A) Multidrug resistance protein
(B) Acetylcholine receptor
(C) Bacteriorhodopsin
(D) ATP synthase

Q.13 The catalytic efficiency for an enzyme is definedas

(A) k_{cat}
(B) $\dfrac{v_{max}}{k_{cat}}$
(C) $\dfrac{k_{cat}}{k_m}$
(D) $\dfrac{k_{cat}}{v_{max}}$

Q.14 Of the two diploid species, species I has 36 chromosomes and species II has 28 chromosomes. How many chromosomes would be found in an allotriploid individual?

(A) 42 or 54
(B) 46 or 50
(C) 74 or 86
(D) 84 or 108

Q.15 The RNA primer synthesized during the replication process in bacteria is removed by
(A) DNA gyrase
(B) Primase
(C) DNA polymeraseI
(D) DNA polymerase II

Q.16 The suitable substitution matrix to align closely related sequences is
(A) PAM 250 or BLOSSUM 80
(B) PAM 40 or BLOSSUM 80
(C) PAM 120 or BLOSSUM 40
(D) PAM 250 or BLOSSUM 40

Q17. If $P = \begin{bmatrix} 1 & 1 \\ 2 & 2 \end{bmatrix}$, $Q = \begin{bmatrix} 2 & 1 \\ 2 & 2 \end{bmatrix}$ and $R = \begin{bmatrix} 3 & 0 \\ 1 & 3 \end{bmatrix}$, which one of the following statement is TRUE?

(A) PQ = PR
(B) QR = RP
(C) QP = RP
(D) PQ = QR

Q18. If $u = \log(e^x + e^y)$, then $\dfrac{\partial u}{\partial x} + \dfrac{\partial u}{\partial y} =$

(A) $e^x + e^y$
(B) $e^x - e^y$
(C) $\dfrac{1}{e^x + e^y}$
(D) 1

Q.19 Hypophosphatemia is manifested by an X-linked dominant allele.What proportion of the offsprings from a normal male and an affected heterozygous female will manifest the disease?

(A) $\dfrac{1}{2}$ sons and $\dfrac{1}{2}$ daughters
(B) All daughters and no sons

(C) All sons and no daughters
(D) $\dfrac{1}{4}$ daughters and $\dfrac{1}{4}$ sons

Q.20 One of the eigen value of $P = \begin{bmatrix} 10 & -4 \\ 18 & -12 \end{bmatrix}$ is

(A) 2
(B) 4
(C) 6
(D) 8

Q. 21 – Q. 25 are of numerical answer type.

Q.21 A callus of 5 g dry weight was inoculated on semi-solid medium for growth. The dry weight of the callus was found to increase by 1.5 fold after 10 days of inoculation. The growth index of the culture is _____.

Q.22 A chemostat is operated at a dilution rate of 0.6 h^{-1}. At steady state, the biomass concentration in the exit stream was found to be 30 g l^{-1}. The biomass productivity (g $l^{-1}h^{-1}$) after 3h of steady state operation will be _____.

Q.23 A batch bioreactor is to be scaled up from 10 to 10,000 liters. The diameter of the large bioreactor is 10 times that of the small bioreactor. The agitator speed in the small bioreactor is 450 rpm. Determine the agitator speed (rpm) of the large bioreactor with same impeller tip speed as that of the small bioreactor _____.

Q.24 Calculate the percentage sequence identity for the pairwise alignment given below. _____.

H E L L O –
Y E L L O W

Q.25 In a batch culture, the specific rate of substrate utilization is 0.25 g (g cell mass)-1 h-1 and specific rate of product formation is 0.215 g (g cell mass)-1 h-1. Calculate the yield of product from the substrate(Yp/s)_____.

Q. 26 to Q. 55 carry two marks each.

Q.26 Match the commercial microbial sources in **Group I** with the products in **Group II**.

Group I	Group II
P. Corynebacteriumlilium	1. 2,3-Butane di-ol
Q. Klebsiellaoxytoca	2. Poly-β-hydroxybutyric acid
R. Aspergillusniger	3. Glutamic acid
S. Alcaligeneseutrophus	4. Citric acid

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

Q.27 Match the entries in the **Group I** with the elution conditions in **Group II**.

Group I	Group II
P. Ion-exchange chromatography	1. Isocratic solvent
Q. Hydrophobic column chromatography	2. Ampholytes
R. Gel filtration chromatography	3. Increasing gradient of salt
S. Chromatofocusing	4. Decreasing gradient of polarity

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

Q.28 Determine the correctness or otherwise of the following **Assertion** (a) and **Reason** (r).

Assertion: Immobilization of plant cells can enhance secondary metabolite production during bioreactor cultivation.

Reason: Immobilization protects the plant cells from shear forces in the bioreactor.

(A) Both (a) and (r) are true and (r) is the correct reason for (a).

(B) Both (a) and (r) are true but (r) is not the correct reason for (a).

(C) (a) is true but (r) is false.

(D) (a) is false but (r) is true.

Q.29   Match the cell structures in **Group I** with the organismsin **Group II.**

Group I	**Group II**
P. Endospores	1. Methanobacterium
Q. Bipolar flagella	2. Treponema
R. Pseudomurine in cell wall	3. Spirillum
S. Periplasmic flagella	4. Clostridium

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

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

Q.30   Match the antibioticsin**Group I**with the targets in**Group II.**

Group I	**Group II**
P. Sulfonamide	1. Peptidoglycan synthesis
Q. Quinolones	2. Peptide chain elongation
R. Erythromycin	3. Folic acid biosynthesis
S. Cephalosporin	4. Topoisomerase

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

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

Q.31   In nature, *Agrobacterium tumefaciens* mediated infection of plant cells leads to

P. crown gall disease in plants

Q. hairy root disease in plants

R. transfer of T-DNA into the plant chromosome

S. transfer of Ri-plasmid into the plant cell

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

Q.32   Match the entries in**Group I** with the enzymes in**Group II.**

Group I	**Group II**
P. NAD+	1. Glutathione peroxidase
Q. Selenium	2. Nitrogenase
R. Pyridoxal phosphate	3. Lactate dehydrogenase
S. Molybdenum	4. Glycogen phosphorylase

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

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

Q.33   Match the herbicides in **Group I**with the target enzymesin **Group II.**

Group I	**Group II**
P. Glyphosate	1. Nitrilase
Q. Bromoxynil	2. Acetolactatesynthetase
R. Sulphonylureas	3. Dehalogenase

S. Dalapon   4. 5-Enolpyruvyl shikimate
                                                 3-phosphate synthase
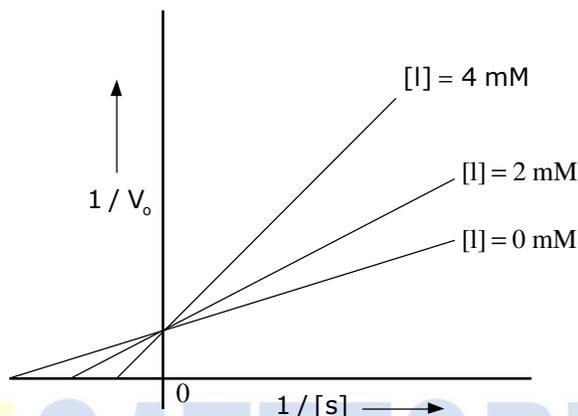
(A) P-4, Q-1, R-2, S-3   (B) P-2, Q-1, R-4, S-3

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

Q.34 The activity of an enzyme was measured by varying the concentration of the substrate (S) in the presence of three different concentrations of inhibitor (I) 0, 2 and 4 mM.The double reciprocal plot given below suggests that the inhibitor (I) exhibits

(A) substrate inhibition   (B) uncompetitive inhibition

(C) mixed inhibition   (D) competitive inhibition

Q.35 Match the entries in **Group I** with the entries in **Group II.**

Group I	**Group II**
P. RNAse P	1. Polyadenylation
Q. RNase H	2. Splicing
R. snRNAs	3. Ribozymes
S. CstF	4. DNA-RNAhybrids

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

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

Q.36 Determine the correctness or otherwise of the following **Assertion** (a) and **Reason** (r).

Assertion: UPGMA method produces ultrametric tree.

Reason: Sequence alignment is converted into evolutionary distances in UPGMA method.

(A) Both (a) and (r) are true and (r) is the correct reason for (a)

(B) Both (a) and (r) are true and (r) is not the correct reason for (a)

(C) (a) is true but (r) is false

(D) (a) is false but (r) is true

Q.37 Match the entries in the **Group I** with the entries in **Group II.**

Group I	**Group II**
P. Threading	1. Gene duplication
Q. FASTA	2. Fold prediction

R. Profile   3. HMM

S. Paralogs   4. k-tuple

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

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

Q38. Evalate $\lim_{x \to \infty} x \tan \dfrac{1}{x}$

(A) ∞ (B) 1   (C) 0   (D)   -1

Q39. The Laplace transform of $f(t) = 2t + 6$ is

(A) $\dfrac{1}{s} + \dfrac{2}{s^2}$ (B) $\dfrac{3}{4} - \dfrac{6}{s^2}$ (C) $\dfrac{6}{s} + \dfrac{2}{s^2}$ (D) $-\dfrac{6}{s} + \dfrac{2}{s^2}$

Q.40 The solution of the following set of equations is

$$x + 2y + 3z = 20$$
$$7x + 3y + z = 13$$
$$x + 6y + 2z = 0$$

(A) $x = -2, y = 2, z = 8$ (B) $x = 2, y = -3, z = 8$

(C) $x = 2, y = 3, z = -8$ (D) $x = 8, y = 2, z = -3$

Q41. The solution to $\dfrac{dy}{dx} + y \cot x = \cos ec\, x$ is

(A) $y = (c+ x)\cot x$ (B) $y = (c+ x)\cos ec\, x$

(C) $y = (c+ x)\cos ec\, x \cot x$ (D) $y = (c+ x)\dfrac{\cos ec\, x}{\cot x}$

Q.42 A complete restriction digestion of a circular plasmid (5000bp) was carried out with *Hind*III,*Bam*HI and*Eco*RI individually. Restriction digestion yielded following fragments.

Plasmid + *Hin*dIII→ 1200bp and 3800bp

Plasmid + *Bam*HI→ 5000bp

Plasmid + *Eco*RI→ 2500bp

The number of sites for *Eco*RI,*Bam*HI and *Hin*dIII present on this plasmid are

(A) *Eco*RI-2, *Bam*HI-1, *Hin*dIII-2   (B) *Eco*RI-1, *Bam*HI-1, *Hin*dIII-2

(C)*Eco*RI-3, *Bam*HI-2, *Hin*dIII-1   (D) *Eco*RI-2, *Bam*HI-2, *Hin*dIII-1

Q. 43 – Q. 47 are of numerical answer type.

Q.43 The total number of fragments generated by the complete and sequential cleavage of the polypeptide given below by Trypsin followed by CNBr is _____.

Phe-Trp-Met-Gly-Ala-Lys-Leu-Pro-Met-Asp-Gly-Arg-Cys-Ala-Gln

Q.44   In a genetic study, 80 people were found to have alleles for polydactyly. Only 36 of them were polydactylous. What is the extent of penetrance percentage? _____ .

Q.45   One percent of the cars manufactured by a company are defective. What is the probability (upto four decimals) that more than two cars are defective, if 100 cars are produced? _____ .

Q.46   The maximum cell concentration (g l-1) expected in a bioreactor with initial cell concentration of

1.75 g l-1 and an initial glucose concentration of 125 g l-1 is ($Y_{x/s}$ = 0.6 g cell/g substrate) _____

Q.47   A fed batch culture was operated with intermittent addition of glucose solution at a flow rate of

200 ml h-1. The values of Ks, K_s, μ_m and D are 0.3 g l^{-1}, 0.4 h^{-1} and 0.1 h^{-1}, respectively. Determine the concentration of growth limiting substrate (gl-1) in the reactor at quasi-steady state. _____ .

**Common Data for Questions 48 and 49:**

A solution was prepared by dissolving 100 mg of protein X in 100 ml of water. Molecular weight of protein X is 15,000 Da; Avogadro's number = 6.022x 1023.

Q.48   Calculate the molarity (μM) of the resulting solution.

(A) 66.6   (B) 6.6   (C) 0.67   (D) 0.067

Q.49   The number of moleculespresent in this solution is

(A) 40.15x1019   (B) 6.023x1019   (C) 4.015x1019   (D) 0.08x1019

Common Data for Questions 50 and 51:

The binding efficiency of three different receptorsR1, R2 and R3 were tested against a ligand using equilibrium dialysis, with a constant concentration of receptor and varying concentrations of ligand. The Scatchard plot of receptor titration with different concentration of ligand is given below

(*r*is moles of bound ligand per moles of receptor and *c* is concentration of free ligand)
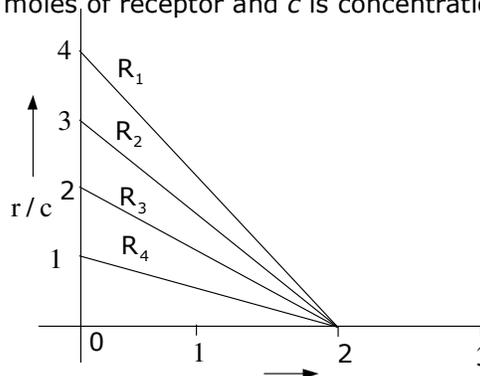
Q.50   The number of ligand binding sites present on receptors R1 and R3, respectively are

(A)1 and 4   (B)1 and 1   (C) 4 and 1   (D) 2 and 2

Q.51   Which one of the receptors has thehighestaffinity for the ligand?

(A) R1   (B) R2   (C) R3   (D) R4

Statement for Linked Answer Questions 52 and 53:

A DNA fragment of 5000bp needs to be isolated from *E.coli* (genome size 4x103kb) genomic library.

Q.52   The minimum number of independent recombinant clones required to represent this fragment in

genomic library are

(A) 16x102   (B)12x102   (C) 8x102   (D) 1.25x102

Q.53   The number of clones to represent this fragment in genomic library with a probability of 95% are

(A) 5.9 x103   (B) 4.5x103   (C) 3.6 x103   (D) 2.4x103

Statement for Linked Answer Questions 54 and 55:

During sterilization of a fermentation medium in a given bioreactor $\nabla_{heating} = 12.56$, $\nabla_{cooling} = 7.48$ and the total value of ∇ required for whole sterilization process is 52, where ∇ is the design criteria.

Q.54   What is the value of ∇ holding?

(A) 31.96   (B) 42.32   (C) 52.43   (D) 61.18

Q.55   What is the holding period (min) at a k value of 3.36min-1?

(A) 10.6   (B) 9.5   (C) 8.4   (D) 7.2

General Aptitude (GA) Questions
Q. 56 – Q. 60 carry one mark each.

Q.56   If $3 \leq X \leq 5$ and $8 \leq Y \leq 11$ then which of the following options is TRUE?

(A) $\frac{3}{5} \leq \frac{X}{Y} \leq \frac{8}{5}$ (B) $\frac{3}{11} \leq \frac{X}{Y} \leq \frac{5}{8}$

(C) $\frac{3}{11} \leq \frac{X}{Y} \leq \frac{8}{5}$ (D) $\frac{3}{5} \leq \frac{X}{Y} \leq \frac{8}{11}$

Q.57   The Headmaster _____ to speak to you.

Which of the following options is incorrect to complete the above sentence?

(A) is wanting   (B) wants   (C) want   (D) was wanting

Q.58   Mahatama Gandhi was known for his humility as

(A) he played an important role in humiliating exit of British from India.

(B) he worked for humanitarian causes.

(C) he displayed modesty in his interactions.

(D) he was a fine human being.

Q.59 <u>All engineering students</u> <u>should learn mechanics,</u> <u>mathematics and</u> <u>how to do computation</u>.

       I   II   III   IV

Which of the above underlined parts of the sentence is not appropriate?

(A) I   (B) II   (C) III   (D) IV

Q.60 Select the pair that best expresses a relationship similar to that expressed in the pair:

water: pipe::

(A) cart: road   (B) electricity: wire (C) sea: beach   (D)music: instrument

Q. 61 to Q. 65 carry two marks each.

Q.61 Velocity of an object fired directly in upward direction is given by V=80-32t, where t (time) is in seconds. When will the velocity be between 32 m/sec and 64 m/sec?

(A) (1, 3/2)   (B) (1/2, 1)   (C) (1/2, 3/2)   (D) (1, 3)

Q.62 In a factory, two machines M1 and M2 manufacture 60% and 40% of the autocomponents respectively. Out of the total production, 2% of M1 and 3% of M2 are found to be defective. If a randomly drawn autocomponent from the combined lot is found defective, what is the probability that it was manufactured by M2?

(A) 0.35   (B) 0.45   (C) 0.5   (D) 0.4

Q.63 Following table gives data on tourists from different countries visiting India in the year 2011.

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

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

2011?

(A) USA and Japan   (B) USA and Australia

(C)England and France   (D) Japan and Australia

Q.64 If $|-2X+9| = 3$ then the possible value of $|-2X+9| = 3$ would be:

(A) 30   (B) -30   (C) -42   (D) 42

Q.65   All professors are researchers

Some scientists are professors

Which of the given conclusions is logically valid and is inferred from the above arguments:

(A) All scientists are researchers   (B) All professors are scientists

(C) Some researchers are scientists   (D) No conclusion follows