Sample Paper

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BT: Biotechnology

Q.No. 1 If the nucleotide composition (%) of a viral genome is A = 10, U = 20, C = 40, and G = 30, which one of the following is this genome?

(A) Double stranded RNA

(B) Single stranded RNA

(C) Single stranded DNA

(D) Double stranded DNA

Answer: (B)

Q.No. 2 Which one of the following amino acids is catalyzed by activated macrophages to produce reactive nitrogen species?

(A) Arginine

(B) Asparagine

(C) Cysteine

(D) Histidine

Answer: (A)

Q.No. 3 What is the solution of the differential equation $\$\frac{dy}{dx} = \frac{x}{y}\$$ with the initial condition, at x=0, y = 1?

(A) $x^2 = y^2 + 1$

(B) $y^2 = x^2 + 1$

(C) $y^2 = 2x^2 + 1$

(D) $x^2 – y^2 = 0$

Answer: (B)

Q.No. 4 Which of the following are geometric series? P. 1, 6, 11, 16, 21, 26, … Q. 9, 6, 3, 0, -3, -6, … R. 1, 3, 9, 27, 81, … S. 4, -8, 16, -32, 64, …

(A) P and Q only

(B) R and S only

(C) Q and S only

(D) P, Q and R only

Answer: (B)

Q.No. 5 Which one of the following is catabolized during endogenous metabolism in a batch bacterial cultivation?

(A) internal reserves

(B) extracellular substrates

(C) extracellular products

(D) toxic substrates

Answer: (A)

Q.No. 6 EcoRI restriction sites on a 10kb DNA fragment are shown below.



Upon partial digestion, what are the lengths (in kb) of all the possible DNA fragments obtained?

(A) 2, 3, 4, 5.6.7, S. and 10

(B) 2, 3, 4, 5, 6, and 7

(C) 2, 3, 4, and 7

(D) 2 and 3

Answer: (A)

Q.No. 7 Standard error is

(A) the probability of a type I error in a statistical test

(B) the error in estimating a sample standard deviation

(C) the standard deviation of a variable that follows standard normal distribution

(D) the standard deviation of distribution of sample means

Answer: (D)

Q.No. 8 The Laplace transform of the function $f(t) = t^2 + 2t + 1$ is

(A) $\frac{1}{s^3} + \frac{3}{s^2} + \frac{1}{s}$

(B) $\frac{4}{s^3} + \frac{4}{s^2} + \frac{1}{s}$

(C) $\frac{1}{s^3} + \frac{2}{s^2} + \frac{1}{s}$

(D) $\frac{2}{s^3} + \frac{2}{s^2} + \frac{1}{s}$

Answer: (D)

Q.No. 9 In leguminous plants, both the rhizobium genes and the plant genes influence nodulation and nitrogen fixation. Which one of the following functions is NOT encoded by the host plant genes?

(A) Production of inducers that modify rhizobial cell wall

(B) Production of flavonoid inducers

(C) Establishment of contact between bacteria and legume

(D) Root hair curling

Answer: (D)

Q.No. 10 DNA synthesis in eukaryotes occurs during which phase of the mitotic cell cycle?

(A) M

(B) G1

(C) S

(D) G0

Answer: (C)

Q.No. 11 Which one of the following equations represents a one-dimensional wave equation?

(A) $\frac{\partial u}{\partial t} = c^2 \frac{\partial^2 u}{\partial x^2}$

(B) $\frac{\partial^2 u}{\partial t^2} = c^2 \frac{\partial^2 u}{\partial x^2}$

(C) $\frac{\partial^2 u}{\partial t^2} = c^2 \frac{\partial u}{\partial x}$

(D) $\frac{\partial^2 u}{\partial t^2} + \frac{\partial^2 u}{\partial x^2} = 0$

Answer: (B)

Q.No. 12 5′ capping of mRNA transcripts in eukaryotes involves the following events: P. Addition of GMP on the 5′ end Q. Removal of γ-phosphate of the triphosphate on first base at the 5′ end R. 5′-5′ linkage between GMP and the first base at 5′ end S. Addition of methyl group to N7 position of guanine Which one of the following is the correct sequence of events?

(A) P, Q, R, S

(B) P, R, Q, S

(C) Q, P, R, S

(D) Q, P, S, R

Answer: (C)

Q.No. 13 The repeat sequence of telomere in humans is

(A) 5′-TATAAT-3′

(B) 5′-TTAGGG-3′

(C) 5′-GGGCCC-3′

(D) 5′-AAAAAA-3′

Answer: (B)

Q.No. 14 Which one of the following bioreactor configurations is the basis for a trickling biological filter?

(A) Stirred tank

(B) Packed bed

(C) Air lift

(D) Fluidized bed

Answer: (B)

Q.No. 15 An enzyme catalyzes a reaction by

(A) decreasing the energy of the substrate.

(B) decreasing the activation energy of the reaction.

(C) decreasing product stability.

(D) increasing the activation banier of the reaction.

Answer: (B)

Q.No. 16 Which of the following statements are CORRECT about the function of fetal bovine serum in animal cell culture? P. It stimulates cell growth Q. It enhances cell attachment R. It provides hormones and minerals S. It maintains pH at 7.4

(A) P and Q only

(B) P and S only

(C) P, Q and R only

(D) P, Q, R and S

Answer: (C)

Q.No. 17 Match the industrial products mentioned in Group I with their producer organisms in

Group I	**Group II**
P. Citric acid	1. *Trichoderma viride*
Q. Cellulase	2. *Clostridium acetobutylicum*
R. Vitamin B_{12}	3. *Aspergillus niger*
S. Butanol	4. *Propionibacterium freudenreichii*

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

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

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

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

Answer: (D)

Q.No. 18 Consider an unfair coin. The probability of getting heads is 0.6. If you toss this coin twice, What is the probability that the first or the second toss is heads?

(A) 0.56

(B) 0.64

(C) 0.84

(D) 0.96

Answer: (C)

Q.No. 19 During protein synthesis, tRNAs are NOT involved in

(A) charging

(B) initiation

(C) elongation

(D) termination

Answer: (D)

Q.No. 20 Which one of the following metabolic processes in mammalian cells does NOT occur in the mitochondria?

(A) Citric acid cycle

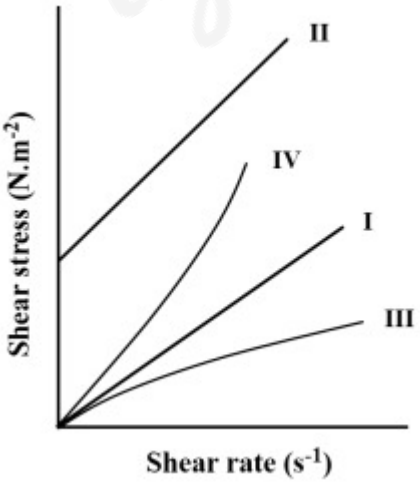
(B) Oxidative phosphorylation

(C) Fatty acid β-oxidation

(D) Glycolysis

Answer: (D)

Q.No. 21 Shear stress versus shear rate behavior of four different types of fluids (I, II, III and IV) are shown in the figure below.



Which one of the following options is correct?

(A) I-Newtonian, II-Bingham plastic, III-Dilatant, IV-Pseudoplastic

(B) I-Pseudoplastic, II-Dilatant, III-Newtonian, IV-Bingham plastic

(C) I-Newtonian, II-Pseudoplastic, III-Bingham plastic, IV-Dilatant

(D) I-Newtonian, II-Bingham plastic, III-Pseudoplastic, IV-Dilatant

Answer: (D)

Q.No. 22 Which of the following are true about bacterial superoxide dismutase? P. Present in obligate aerobes Q. Present in facultative anaerobes R. Present in aerotolerant anaerobes S. Absent in obligate aerobes

(A) P and Q only

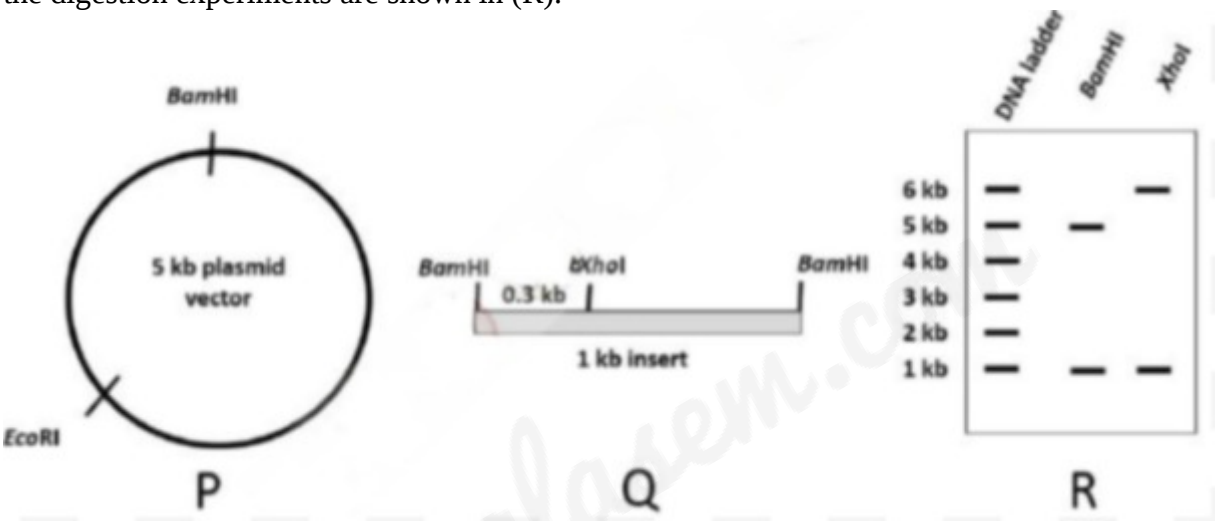
(B) P, Q and R only

(C) P and R only

(D) Q and S only

Answer: (B)

Q.No. 23 Shown below is a plasmid vector (P) and an insert (Q). The insert was cloned into the BamHI siteof the vector. The recombinant plasmid was isolated and digested with BamHI or XhoI. The results from the digestion experiments are shown in (R).



Which one of the following explains the digestion results shown in (R)?

(A) The insert did not ligate to the vector.

(B) One copy of the insert ligated to the vector.

(C) The insert ligated to the vector as two tandem copies.

(D) The insert ligated to the vector as two copies but not in tandem.

Answer: (C)

Q.No. 24 A mixture contains three similarly sized peptides P, Q and R. The peptide P is positively charged, Q is weakly negative and R is strongly negative. If this mixture is passed through an ion-exchange chromatography column containing an anionic resin, their order of elution will be

(A) P, Q, R

(B) R, Q, P

(C) Q, R, P

(D) P, Q and R elute together

Answer: (B)

Q.No. 25 Which of the following factors can influence the lag phase of a microbial culture in a batch fermentor? P. Inoculum size Q. Inoculum age R. Medium composition

(A) P and Q only

(B) Q and R only

(C) P and R only

(D) P, Q and R

Answer: (D)

Q.No. 26 Some of the cytokinins used in plant tissue culture media are given below: [P] BAP [QI Zeatin [R] Kinetin [S] 2iP

(A) P and Q only

(B) Q and S only

(C) R and S only

(D) P and R only

Answer: (D)

Q.No. 27 Amino acid sequences of cytochrome c and ribulose 5-phosphate epimerase from 40 organisms were chosen and phylogenetic trees were obtained for each of these two protein families. Determine the correctness or otherwise of the following Assertion [a] and the Reason[r] Assertion[a]: The two trees will not be identical Reason[r]: The nature and frequency of mutations in the two families are different

(A) Both [a] and [rl 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 false but [r] is true.

Answer: (A)

Q.No. 28 Match the organelles in Group I with their functions in Group II.

Group I	Group II
P. Lysosome	1. Digestion of foreign substances
Q. Smooth ER	2. Protein targeting
R. Golgi apparatus	3. Lipid synthesis
S. Nucleolus	4. Protein synthesis
	5. rRNA synthesis

(A) P-1, Q-3, R-2, S-5

(B) P-1, Q-4, R-5, S-3

(C) P-2, Q-5, R-3, S-4

(D) P-1, Q-3, R-4, S-5

Answer: (A)

Q.No. 29 Match the proteins in Group I with cellular processes in Group II

Group I	Group II
P. p53	1. DNA packaging
Q. Lysozyme	2. Apoptosis
R. Tubulins	3. Hydrolysis of polysaccharides
S. Histones	4. Chromosome segregation

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

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

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

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

Answer: (D)

Q.No. 30 A recombinant protein is to be expressed under the control of the Iac promoter and operator in a strain of E. coli having the genotype $lacI^+$ crp^+. Even in the absence of inducer IPTG, low levels of expression of the recombinant protein are seen (leaky expression). Which one of the following should be done to minimize such leaky expression?

(A) Addition of lactose to the medium

(B) Removal of all glucose from the medium

(C) Addition of excess glucose to the medium

(D) Addition of allo-lactose to the medium

Answer: (C)

Q.No. 31 Match the classes of RNA molecules in Group I with their functions in Group II.

Group I	Group II
P. snoRNA	1. Protects germline from transposable elements
Q. piRNA	2. Blocks translation of selected mRNA
R. miRNA	3. Template for telomere elongation
S. snRNA	4. Modification and processing of rRNA
	5. Splicing of RNA transcripts

(A) P-3, Q-5, R-2, S-4

(B) P-1, Q-3, R-2, S-5

(C) P-1, Q-4, R-5, S-2

(D) P-4, Q-1, R-2, S-5

Answer: (D)

Q.No. 32 Match the human diseases in Group I with the causative agents in Group II.

Group I	Group II
P. Amoebiasis	1. *Leishmania donovani*
Q. African sleeping sickness	2. *Trypanosoma cruzi*
R. Kala azar	3. *Entamoeba histolytica*
S. Chagas' disease	4. *Trypanosoma gambiense*

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

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

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

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

Answer: (C)

Q.No. 33 Which one of the following statements is true for actin?

(A) Actin filament is structurally polarized and the two ends are not identical

(B) De novo actin polymerization is a single-step process

(C) The pointed end of the actin filaments is the fast growing end

(D) Actin forms spindle fibers during mitosis

Answer: (A)

Q.No. 34 Determine the correctness or otherwise of the following Assertion [a] and the Reason[r] Assertion [a]: Embryonic stem cells are suitable for developing knockout mice Reason [r]: Homologous recombination is more frequent in embryonic stem cells than that in somatic cells

(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 false but [r] is true

Answer: (A)

Q.No. 35 Determine the correctness or otherwise Of the following Assertion and the Reason [r] regarding mammalian cells. Assertion[a]: Cells use $Ca2^{+}$, and not Na^{+}, for cell-to-cell signaling Reason[r]: In the l, concentration of Na^{+} is lower than that of $Ca2^{+}$

(A) Both [a] and [rl 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.

Answer: (D)

Q.No. 36 Ras protein is a

(A) trimeric GTPase involved in relaying signal from cell surface to nucleus.

(B) monomeric GTPase involved in relaying signal from cell surface to nucleus.

(C) trimeric GTPase involved in regulation of cytoskeleton.

(D) monomeric GTPase involved in regulation of cytoskeleton.

Answer: (B)

Q.No. 37 Match subcellular organelles listed in Group I with their features listed in Group II:

Group I	Group II
[P] Mitochondrion	1. Single-membrane enclosed
[Q] Chloroplast	2. Double-membrane enclosed
[R] Nucleus	3. Maternal inheritance
[S] Endoplasmic reticulum	4. Endosymbiotic origin

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

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

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

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

Answer: (B)

Q.No. 38 In eukaryotes, cytokinesis is inhibited by

(A) cytochalasin D

(B) vinblastine

(C) nocodazole

(D) colchicine

Answer: (A)

Q.No. 39 Which of the following technique(s) can be used to study conformational changes in myoglobin? P. Mass spectrometry Q. Fluorescence spectroscopy R. Circular dichroism spectroscopy S. Light microscopy

(A) P only

(B) P and S only

(C) Q and R only

(D) S only

Answer: (C)

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Q.No. 40 Which one of the following CANNOT be a recognition sequence for a Type II restriction enzyme?

(A) GAATTC

(B) AGCT

(C) GCGGCCGC

(D) ATGCCT

Answer: (D)

Q.No. 41 Protein p becomes functional upon phosphorylation Of a serine residue. Replacing this serine with _____ will result in a phosphomimic mutant of P.

(A) alanine

(B) aspartic acid

(C) phenylalanine

(D) lysine

Answer: (B)

Q.No. 42 Which one of the following is the solution for cos2x + 2cosx + 1 = 0, for values of x in the range of 0° < x < 360°?

(A) 45°

(B) 90°

(C) 180°

(D) 270°

Answer: (C)

Q.No. 43 The genome is diploid at the end of which phases of a human mitotic cell cycle?

(A) G2 & S

(B) G1 & M

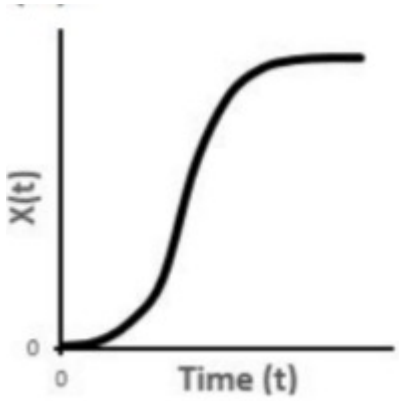
(C) M & S

(D) G1 & G2

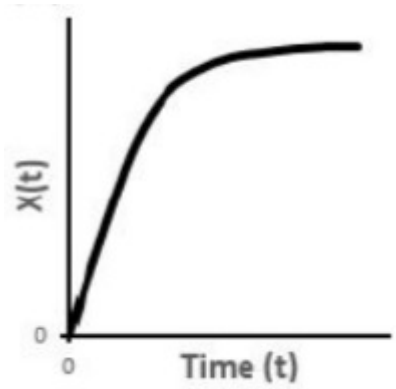
Answer: (B)

Q.No. 44 Growth of a microbe in a test tube is modeled as $\frac{dX}{dt} = rX\left(1 - \frac{X}{K}\right)$, where, X is the biomass, r is the growth rate, and K is the carrying capacity of(c) only Y-linked the environment $(r \neq 0; K \neq 0)$. If the value of starting biomass is $\frac{K}{100}$ which one of the following graphs qualitatively represents the growth dynamics?

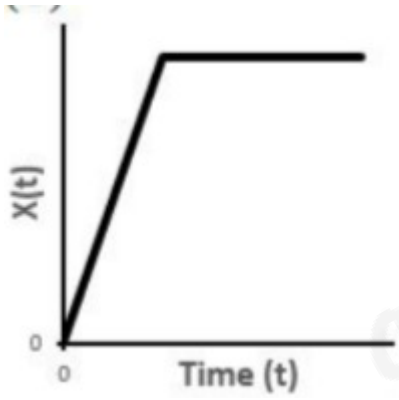
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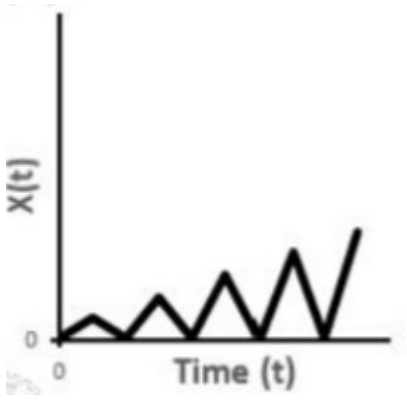
(A)



(B)



(C)



(D)

Answer: (A)

Q.No. 45 Which class Of antibody is first made by developing B cells inside bone marrow?

(A) IgG

(B) IgE

(C) IgA

(D) IgM

Answer: (D)

Q.No. 46 Which one of the following is NOT a part of the human nonspecific defense system?

(A) Interferon

(B) Mucous

(C) Saliva

(D) Antibody

Answer: (D)

Q.No. 47 Match the organisms in Column I with the characteristics in Column II

Column I	Column II
P. Meth anococcus	1. Halophile
Q. Dunaliella	2. Acidophile
R. Sulfolobus	3. Mesophile
S. Escherichia	4. Barophile

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

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

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

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

Answer: (D)

Q.No. 48 Which of the following are true with regard to anaerobic respiration in bacteria? P. The final electron acceptor is an inorganic substance other than molecular oxygen Q. The number of ATP molecules produced per glucose molecule is more than that produced in aerobic respiration R. The number of ATP molecules produced per glucose molecule is less than that produced in aerobic respiration S. Only substrate level phosphorylation is used to generate ATP

(A) P and S only

(B) Q and S only

(C) P and R only

(D) P, Q and S only

Answer: (C)

Q.No. 49 Vincristine and vinblastine, two commercially important secondary metabolites from Calharanlhus roseus, are examples of

(A) alkaloids.

(B) flavonoids.

(C) terpenoids.

(D) steroids.

Answer: (A)

Q.No. 50 Natural proteins are composed primarily of 20 a-amino acids. Which one of the following statements is tme for any of these amino acids in a solution of pH 1.5?

(A) Only the amino group is ionized.

(B) Only the carboxylic acid group is ionized

(C) Both amino and carboxylic acid groups are ionized.

(D) Both amino and carboxylic acid groups are neutral.

Answer: (A)

Q.No. 51 Which one of the following is INCORRECT about protein structures?

(A) A protein fold is stabilized by favorable non-covalent interactions

(B) All parts of a fold can be classified as helices, strands or turns

(C) Two non-covalent atoms cannot be closer than the sum of their van der Waals radii

(D) The peptide bond is nearly planar.

Answer: (B)

Q.No. 52 Which Of the following statements about immune response are CORRECT? [P] T cells are activated by antigen-presenting cells [QI Foreign peptides are not presented to helper T cells by Class II MHC proteins [R] Dendritic cells are referred to as professional antigen-presenting cells

(A) P and Q only

(B) P and R only

(C) Q and R only

(D) P,Q and R

Answer: (A)

Q.No. 53 Which one of the following media components is used to maintain pH in mammalian cell culture?

(A) $CaCl_2$

(B) $MgSO_4$

(C) NaCl

(D) $NaHCO_3$

Answer: (D)

Q.No. 54 The Bt toxin gene from Bacillus thuringiensis used to generate genetically modified crops is

(A) cry

(B) cro

(C) cdc

(D) cre

Answer: (A)

Q.No. 55 A list of pathogens (Group I) and a list of anti-microbial agents (Group II) used to treat their infections are given below. Match the pathogens with the corresponding anti-microbial agents.

Group I	Group II
[P] Influenza A virus	1. Isoniazid
[Q] Fungus	2. Amantadine
[R] Plasmodium	3. Fluconazole
[S] Mycobacterium	4. Artemisinin
	5. Iodoquinol

(A) P-4, Q-3, R-2, S-5

(B) P-5, Q-2, R-4, S-1

(C) P-2. 0-3. R-4. S-1

(D) P-2, Q-3, R-1, S-5

Answer: (B)