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2007
XL : Life Sciences

Duration : Three Hours

Maximum Marks :150

Read the following instructions carefully.

1. This question paper contains **six** sections as listed below. Each section contains **28** objective questions. Q.1 to Q.6 carry **one** mark each and Q.7 to Q.28 carry **two** marks each.

Section	Page	Section	Page
H. Chemistry	02	K. Botany	19
I. Biochemistry	08	L. Microbiology	27
J. Biotechnology	13	M. Zoology	31

2. Section H is compulsory. Choose **two** more sections from the remaining.
3. Using HB pencil, mark the sections you have chosen by darkening the appropriate bubbles on the left hand side of the Objective Response Sheet (**ORS**) provided. **Make sure you have correctly bubbled the sections you have chosen. ORS will not be evaluated if this information is NOT marked.**
4. Questions must be answered on **ORS** by darkening the appropriate bubble (marked A, B, C, D) using HB pencil against the question number on the left hand side of the ORS under the sections you have chosen. Each question has only one correct answer. In case you wish to change an answer, erase the old answer completely.
5. Wrong answers will carry NEGATIVE marks. In Q.1 to Q.6 of each section, **0.25** mark will be deducted for each wrong answer. In Q.7 to Q.25 and in Q.27 **0.5** mark will be deducted for each wrong answer. However, there is no negative marking in Q.26 and in Q.28. More than one answer bubbled against a question will be taken as an incorrect response. Unattempted questions will not carry any marks.
6. Write your registration number, your name and name of the examination centre at the specified locations on the right half of the **ORS**.
7. Using HB pencil, darken the appropriate bubble under each digit of your registration number and the letters corresponding to your paper code.
8. Calculator is allowed in the examination hall.
9. Charts, graph sheets or tables are NOT allowed in the examination hall.
10. Rough work can be done on the question paper itself. Additionally blank pages are given at the end of the question paper for rough work.
11. This question paper contains **40** printed pages including pages for rough work. Please check all pages and report, if there is any discrepancy.

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S/121 Food/06–XL–1A

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H : Chemistry (Compulsory)

Q. 1 – Q. 6 carry one mark each.

Q.1 On the basis of VSEPR theory, the molecule which has a linear structure is

(A) SO_2 (B) N_2O (C) Cl_2O (D) NO_2

Q.2 The geometries of $[NiCl_4]^{2-}$ and $[PdCl_4]^{2-}$ respectively are

(A) Tetrahedral and square planar
(B) Both tetrahedral
(C) Both square planar
(D) Square planar and tetrahedral

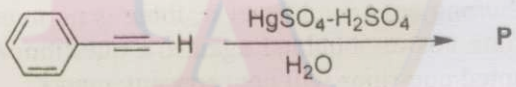
Q.3 The ionization energy of hydrogen atom in ground state is 13.6 eV. The ionization energy of Li^{2+} in ground state would be

(A) 1.51 eV (B) 4.53 eV (C) 40.8 eV (D) 122.4 eV

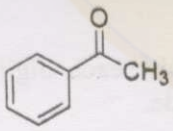
Q.4 The half-life of ^{14}C is 5730 years. An old sample of wood contains 25% of ^{14}C as would be found in a current living tree. The age of the sample of wood would be

(A) 1432 years (B) 2865 years (C) 5730 years (D) 11460 years

Q.5 The product 'P' formed in the following reaction is



(A)



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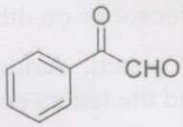

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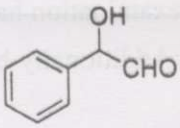

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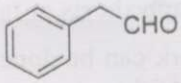

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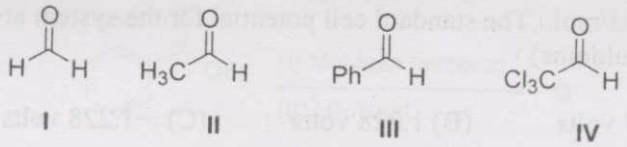
Q.6 The order of reactivity of the following aldehydes with a nucleophile is



I II III IV

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

Q. 7 – Q. 24 carry two marks each.

Q.7 In the nuclear reaction of $^{235}_{92}U$ with a neutron, two elements, Kr and '**Y**', are formed along with three neutrons.

$$^{235}_{92}U + ^{1}_{0}n \rightarrow ^{91}_{36}Kr + 3\,^{1}_{0}n + \text{'Y'}$$

The element '**Y**' is

(A) $^{142}_{56}Ba$ (B) $^{142}_{55}Cs$ (C) $^{142}_{54}Xe$ (D) $^{142}_{53}I$

Q.8 Which of the following statements is true about diatomic species He_2 and He_2^+?

(A) He_2 is stable AND He_2^+ is stable
(B) He_2 is stable AND He_2^+ is unstable
(C) He_2 is unstable AND He_2^+ is stable
(D) He_2 is unstable AND He_2^+ is unstable

Q.9 For the reaction $A \rightleftharpoons B$, the activation energy for the forward reaction is 123 kJ/mol. The activation energy for the reverse reaction is 140 kJ/mol. The enthalpy change for the forward reaction is

(A) 263 kJ/mol (B) −263 kJ/mol (C) 17 kJ/mol (D) −17 kJ/mol

Q.10 The acid dissociation constant of a weak acid HA is 10^{-5}. A 0.20 M solution of the acid HA also contains 0.10 M of salt MA_2. The pH of the solution is

(A) 0.69 (B) 1.0 (C) 2.85 (D) 5.0

Q.11 The attractive part of the van der Waals interaction, $-B/r^6$, where B is a positive coefficient and r is the distance between the molecules, is governed by

(A) dipole-dipole interaction
(B) charge-dipole interaction
(C) induced dipole-induced dipole interaction
(D) dipole-induced dipole interaction

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Q.12 A fuel cell is based on the idea of the reaction $H_2(g) + \frac{1}{2}O_2(g) \rightarrow H_2O(l)$ generating electricity. The standard free energy change (ΔG^o) for this reaction at 298 K is –237.13 kJ/mol. The standard cell potential for the system at 298 K is (1 Faraday = 96500 coulombs)

(A) 2.457 volts (B) 1.228 volts (C) –1.228 volts (D) –2.457 volts

Q.13 The electron-deficient molecule is

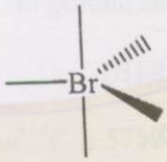
(A) N_2H_4 (B) C_2H_6 (C) B_2H_6 (D) O_2H_2

Q.14 The complex with crystal field stabilization energy (CFSE) of $-0.4\ \Delta_t$ is

(A) $[TiCl_4]$ (B) $[MnCl_4]^{2-}$ (C) $[CoCl_4]^{2-}$ (D) $[CuCl_4]^{2-}$

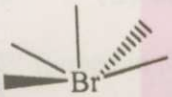
Q.15 The most stable geometry of BrF_5 is

(A)



(B)

(C)



(D)

Q.16 The species having three unpaired electrons and tetrahedral geometry is

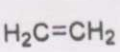
(A) $[Co(CN)_6]^{4-}$ (B) $[CoCl_4]^{2-}$ (C) $[Ni(CN)_4]^{2-}$ (D) $[NiCl_4]^{2-}$

Q.17 The correct arrangement of group 13 elements in terms of increasing average M-Cl bond energy in MCl_3 compounds is

(A) Al > Ga > In > Tl
(B) Tl > In > Ga > Al
(C) Al > Ga > Tl > In
(D) Ga > In > Tl > Al

Q.18 Which of the following olefins leads to a racemic mixture of the diol product upon *cis*-dihydroxylation?

(A)



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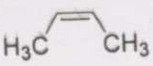

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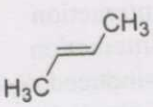

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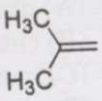

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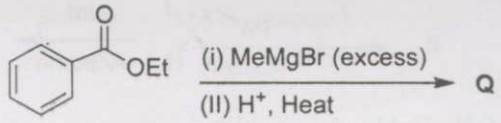
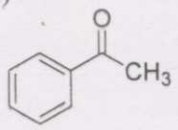
Q.19 The major product '**Q**' formed in the following reaction is



(A)


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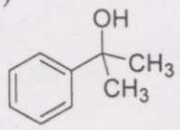

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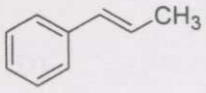
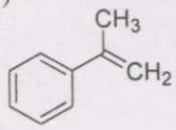
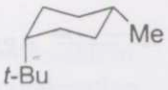
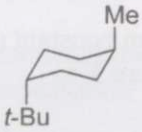


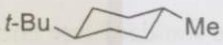
(D)


Q.20 The most stable conformation of *cis*-1-*tert*-butyl-4-methylcyclohexane is

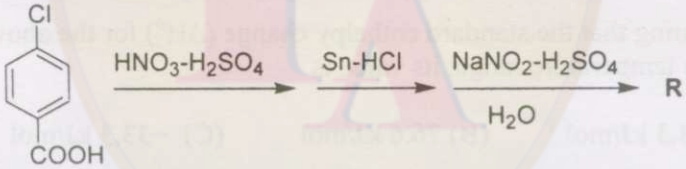
(A)


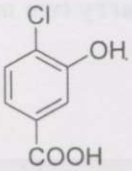
(B)


(C)

(D)


Q.21 The major product '**R**' formed in the following reaction sequence is



(A)


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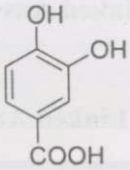

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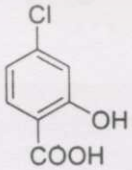

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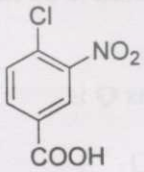

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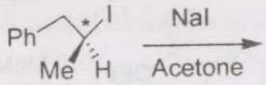
Q.22 The following optically active compound undergoes racemization upon reaction with NaI in acetone.



The pathway followed by the reaction is

(A) S_N1 (B) S_N2 (C) E1 (D) E2

Common Data Questions

Common Data for Questions 23 & 24:

The equilibrium constant (K) for the reaction Ag_2CO_3 (s) $\rightleftharpoons$ Ag_2O (s) + CO_2 (g) varies with temperature T as

T(in K)	400	500
K	1.41×10^{-2}	1.41

Q.23 The standard free energy change (ΔG^o) for the above reaction at 500 K is ($R = 8.314\ J\ K^{-1}mol^{-1}$)

(A) −0.62 kJ/mol (B) −1.43 kJ/mol (C) 0.62 kJ/mol (D) 1.43 kJ/mol

Q.24 Assuming that the standard enthalpy change (ΔH^o) for the above reaction is constant in this temperature range, its value is

(A) 33.3 kJ/mol (B) 76.6 kJ/mol (C) −33.3 kJ/mol (D) −76.6 kJ/mol

Linked Answer Questions: Q. 25 to Q. 28 carry two marks each.

Statement for Linked Answer Questions 25 & 26:

A solid compound **X** on heating produces a new solid **P** and a gas **Q**. The gas **Q** is absorbed by KOH.

Q.25 The gas **Q** is

(A) CO_2 (B) O_2 (C) N_2 (D) NH_3

Q.26 The reaction between **P** and water forms a new compound **R**. Compound **R** gives bleaching powder on reaction with Cl_2. The compound **X** is

(A) NH_4NO_2 (B) $KClO_3$ (C) $CaCO_3$ (D) $CuFeS_2$

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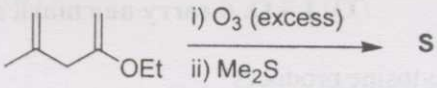
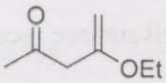
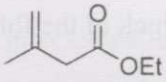
Statement for Linked Answer Questions 27 & 28:



Q.27 The structure of 'S' is

(A)


(B)


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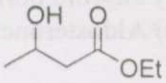

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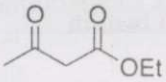

Q.28 The name reaction by which the product 'S' may be readily prepared is

(A) Aldol condensation
(B) Benzoin condensation
(C) Claisen condesation
(D) Perkin condensation

END OF THE SECTION

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Q. 1 – Q. 6 carry one mark each.

Q.1 Deamination of cytosine produces

(A) Uracil
(B) Pseudouracil
(C) Hypoxanthine
(D) 5-Methyluracil

Q.2 Which of the following hormones binds to a cell surface receptor?

(A) Estrogen
(B) Thyroid hormone
(C) Insulin
(D) Aldosterone

Q.3 Systemic lupus erythematosus (SLE), an autoimmune disease, is characterized by the presence of

(A) Anti-DNA antibodies
(B) Anti-thyroglobulin antibodies
(C) Anti-insulin antibodies
(D) Anti-collagen antibodies

Q.4 Optical density of 1 means

(A) 1% of the incident light is absorbed
(B) 1% of the incident light is transmitted
(C) 90% of the incident light is absorbed
(D) 90% of the incident light is transmitted

Q.5 One of the carbon atoms of a glucose molecule is [^{14}C]-labeled. If $^{14}CO_2$ is released during the conversion of pyruvate to acetyl coenzyme-A, which carbon atom of glucose was radiolabeled?

(A) C3 but not C4
(B) C3 or C4
(C) C1 or C6
(D) C1 but not C6

Q.6 When yeast cells are shifted from a medium containing glycerol to glucose, an increase in the transcription of four genes involved in glucose metabolism was reported. Which of the following would be the most appropriate technique to demonstrate increased transcription of these genes?

(A) Southern hybridization
(B) Northern hybridization
(C) Western hybridization
(D) Fluorescence *in situ* hybridization

Q. 7 – Q. 24 carry two marks each.

Q.7 A mixture containing protein-1, -2, -3, -4, and -5 with molecular weights 5,000, 10,000, 25,000, 65,000, and 100,000, respectively, were separated on a Sephadex G-50 column. The order of elution of these proteins from the column will be

(A) Protein-1, protein-2, protein-3, protein-4, and protein-5
(B) Protein-5, protein-4, protein-3, protein-2, and protein-1
(C) Protein-1, -2, and -3 elute first, followed by protein-5 and -4
(D) Protein-4 and -5 elute first, followed by protein-3, -2, and -1

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Q.8 The maximum number of hydrogen bonds that a molecule of water can form is

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(A) 1 (B) 2 (C) 3 (D) 4

Q.9 Match the techniques mentioned in Column A with their applications given in Column B.

A	B
P. PCR	1. Identification of transcription factor binding sites in chromatin
Q. DNA microarray	2. Identification of HIV infected patients using serum samples
R. ELISA	3. Isolation of mouse homologue of a yeast gene
	4. Analysis of differential gene expression in cancer and normal cells

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

Q.10 A nonsense mutation in the gene encoding protein X leading to the synthesis of a truncated protein results in a slow growing strain. Mutagenesis of this strain towards the isolation of extragenic suppressors led to the isolation of a strain which grew normally and synthesized the full-length protein X. The extragenic suppressor is likely to be a gene coding for

(A) rRNA (B) RNA polymerase
(C) tRNA (D) Ribosomal protein

Q.11 The total radioactivity in 1 ml solution containing 0.25 mg of glycine is 1 mCi. The specific activity (mCi/millimole) of radiolabeled glycine will be

(A) 300 (B) 18.75 (C) 3000 (D) 1875

Q.12 Ten grams of butter was saponified. The non-saponifiable fraction was extracted into 25 ml of chloroform. The absorbance of this solution in a 1 cm cuvette is 0.53 at 328 nm. If the extinction coefficient ($a_{1\%}$) of vitamin A at this wavelength is 1550, calculate the amount of vitamin A present.

(A) 3.419×10^{-3} g/100 ml (B) 3.419×10^{-6} g/100 ml
(C) 3.419×10^{-5} g/100 ml (D) 3.419×10^{-4} g/100 ml

Q.13 Folate derivatives are required for the synthesis of which deoxynucleotides?

(A) Adenylate and guanylate (B) Cytidylate and thymidylate
(C) Adenylate, guanylate and thymidylate (D) Adenylate, guanylate and cytidylate

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Q.14 Cytochrome C reductase, also called as Complex III or cytochrome bc_1 complex, localized on the inner mitochondrial membrane receives electrons from ubiquinol and donates to cytochrome C. In one cycle,

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(A) Two cytochrome C molecules are reduced
(B) One ubiquinol is oxidized
(C) Two ubiquinols are oxidized and one ubiquinone is reduced
(D) One cytochrome C is reduced

Q.15 Match the biological functions mentioned in Column A with the enzymes given in Column B.

A	B
(P) Diacylglycerol synthesis	(1) Protein kinase A
(Q) CREB phosphorylation	(2) Ras
(R) GTP hydrolysis	(3) Phospholipase C
	(4) Phospholipase D
	(5) Protein kinase G

(A) P-3, Q-1, R-5
(B) P-4, Q-1, R-2
(C) P-3, Q-1, R-2
(D) P-3, Q-5, R-2

Q.16 How does haemoglobin carry carbon dioxide generated in tissues back to the lungs?

(A) By coordination with heme
(B) By forming N-terminal carbamate
(C) By forming C-terminal carbamate
(D) By linking to the epsilon-amino group of lysine

Q.17 Which of the following enzyme activities can be detected in the supernatant obtained by centrifugation of liver homogenate at 100,000 g for 1 hr at 4°C?

(A) Succinate dehydrogenase
(B) Glyceraldehyde 3-phosphate dehydrogenase
(C) Glycogen synthetase
(D) Aconitase

Q.18 Which of the following statements about the enzyme complexes of the electron transport system is correct?

(A) They interact with one another via mobile electron carriers
(B) They are located in the mitochondrial matrix
(C) They can not be separated from one another in a functional form
(D) They all have cytochromes

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Q.19 Match the DNA binding motifs mentioned in Column A with the proteins given in Column B.

A	B
(P) Zinc finger	(1) c-jun
(Q) Leucine zipper	(2) Growth hormone receptor
(R) Helix-turn-helix motif	(3) Glucocorticoid receptor
	(4) Histone H1
	(5) Lambda repressor

(A) P-4, Q-5, R-1
(B) P-2, Q-5, R-4
(C) P-2, Q-1, R-5
(D) P-3, Q-1, R-5

Q.20 Which of the DNA polymerases listed below is primarily responsible for the *de novo* synthesis of new DNA strands?

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

Q.21 F_1F_O-ATPase in chloroplasts is located on the

(A) inner chloroplast membrane with F1 facing the stroma
(B) inner chloroplast membrane with F1 facing the inter-membrane space
(C) thylakoid membrane with F1 facing the stroma
(D) thylakoid membrane with F1 facing the thylakoid lumen

Q.22 In addition to adjuvants, generation of anti-hapten antibodies will require injection of

(A) the hapten to a mice
(B) a mixture of hapten and protein to a mice
(C) the hapten covalently linked to a protein to a mice
(D) a mixture of hapten and lipid to a mice

Common Data Questions

Common Data for Questions 23, 24: The number of protons translocated by the various vectorial proteins localized on the inner mitochondrial membrane of an organism was determined. They are as follows: NADH dehydrogenase: 4, cytochrome bc_1 complex: 2, cytochrome aa_3 complex: 4 and F_1F_O-ATPase: 3. One proton is also required for the transport of inorganic phosphate into the mitochondrial matrix.

Q.23 The number of ATP molecules that can be synthesized by the oxidation of one NADH molecule is

(A) 2 (B) 2.5 (C) 3 (D) 3.3

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Q.24 If the cytosolic NADH is transported to the matrix by the glyceraldehydes 3-phosphate shuttle, then the number of ATPs synthesized is

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(A) 1.5 (B) 2 (C) 2.5 (D) 3.3

Linked Answer Questions: Q. 25 to Q. 28 carry two marks each.

Statement for Linked Answer Questions 25 & 26: Two mammalian cell lines were found to express either epidermal growth factor receptor (EGFR) alone (cell line A) or both EGFR and Ras (cell line B). These cell lines were treated with epidermal growth factor (EGF) and protein phosphorylation was examined in the membrane and cytosolic fractions using anti-phosphotyrosine and anti-phosphoserine antibodies.

Q.25 EGF-dependent tyrosine phosphorylation will be detected in

(A) Membrane and cytosolic fractions of both the cell lines
(B) Only the membrane fraction of only cell line A
(C) Only the membrane fraction of both cell lines
(D) Only the cytosolic fractions of both cell lines

Q.26 EGF-dependent serine phosphorylation will be detected in

(A) membrane and cytosolic fractions of both the cell lines
(B) only the membrane fraction of cell line A
(C) only the membrane fraction of cell line B
(D) only the cytosolic fraction of cell line A

Statement for Linked Answer Questions 27 & 28: $\Delta G^{\circ\prime}$ is the symbol used to denote standard free-energy change of a chemical reaction in biological systems. The standard conditions are T = 298 K, concentration of water = 55.5 M, pH = 7, and the reactants and products (other than water and proton) are initially present at 1 M concentration.

Q.27 Suppose ΔG denotes the free-energy change for the reaction $A + B \rightleftarrows C + H^+$ at pH 5, all other conditions being the same as the standard conditions specified above. Then

(A) $\Delta G = \Delta G^{\circ\prime}$
(B) $\Delta G = \Delta G^{\circ\prime} + 11.5\ RT$
(C) $\Delta G = \Delta G^{\circ\prime} + 4.6\ RT$
(D) $\Delta G = \Delta G^{\circ\prime} + 16.1\ RT$

Q.28 If $\Delta G^{\circ\prime}$ for the reaction is -11.7 kJ/mol and R = 8.314 kJ/mol, the reaction is

(A) Endergonic at both 37°C and 25°C
(B) Endergonic at 37°C and exergonic at 25°C
(C) Exergonic at both 37°C and 25°C
(D) Exergonic at 37°C and endergonic at 25°C

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Q. 1 – Q. 6 carry one mark each.

Q.1 The specific growth rate (μ) of a microorganism in death phase is

(A) 0 (zero)
(B) μ_{max}
(C) less than zero
(D) greater than zero

Q.2 Which of the following reagents is used for harvesting anchorage-dependent animal cells from culture vessels?

(A) Trypsin/Collagenase
(B) Trypsin/Collagen
(C) Collagen/Fibronectin
(D) DMSO

Q.3 Protein binding regions of DNA are identified by one of the following techniques

(A) finger printing
(B) foot printing
(C) southern blotting
(D) western blotting

Q.4 Plant secondary metabolites

(A) help to increase the growth rate of plant
(B) help in plant reproduction processes
(C) provide defense mechanisms against microbial attack
(D) make the plant susceptible to unfavorable conditions

Q.5 Si RNA(s) interfere at

(A) transcriptional level
(B) post-transcriptional level
(C) DNA replication level
(D) translational level

Q.6 Presence of $CX_{2\text{-}4}CX\phi X_8HX_3H$ sequence in a protein suggest that it is

(A) a protein kinase
(B) GTP binding protein
(C) zinc finger protein
(D) lipase

Q. 7 – Q. 24 carry two marks each.

Q.7 A protein binds to phosphocellulose column at pH 7.0 and elutes at pH 8.0. If the protein has to be further purified on a DEAE Sephacel column, the binding buffer should have a pH of

(A) 5
(B) 6
(C) 7
(D) 8

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Q.8 Oils rich in PUFA are NOT desirable for bio-diesel production because https://pathfinderacademy.in/

(A) they form epoxides in presence of oxygen
(B) they do not form epoxides in presence of oxygen
(C) they have high ignition temperature
(D) they solidify at low temperature

Q.9 Gynogenesis is a process of development of haploid plants

(A) from a fertilized cell of female gametophyte
(B) from an unfertilized cell of female gametophyte
(C) from isolated pollen grains
(D) by selective elimination of chromosomes following distant hybridization

Q.10 Match items in group 1 with correct examples from those in group 2

Group 1	Group 2
P. Catabolic product	1. Griseofulvin
Q. Bioconversion	2. Bakers yeast
R. Biosynthetic product	3. 6- Aminopenicillanic acid
S. Cell mass	4. Ethanol

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

Q.11 A bioremedial solution to reduce oxides of nitrogen and carbon in flue gases is to integrate flue gas emission to

(A) micro-algal culture
(B) fish culture
(C) mushroom culture
(D) seri culture

Q.12 The respiratory coefficient for the reaction
$a\ CH_mO_n + b\ O_2 + c\ NH_3 \rightarrow d\ CH_\alpha O_\beta N_\gamma + e\ H_2O + f\ CO_2$ is defined as

(A) f/a
(B) e/b
(C) b/f
(D) f/b

Q.13 Match the methods available on world wide web in group 1 for performing the jobs listed in group 2

Group 1	Group 2
P. Boxshade	1. Searching family data base
Q. BCM launcher	2. Finding alignments
R. Prosite	3 Displaying alignments
S. PSI-BLAST	4. Searching for multiple alignments

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

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Q.14 Match the recombinant products in group 1 with their therapeutic applications in group 2

Group 1	Group 2
P. Human growth hormone	1. Pituitary dwarfism
Q. Platelet growth factor	2. Chemotherapy induced thrombocytopenia
R. Factor VIII	3. Haemophilia
S. Erythropoietin	4. Anaemia associated with chronic renal failure

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

Q.15 Mobile genetic elements present in human genome are
(P) long interspersed elements (LINEs)
(Q) short interspersed elements (SINEs)
(R) P elements
(S) IS elements

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

Q.16 Match the following marker genes in group 1 with suitable selecting agent in group 2

Group 1	Group 2
P. npt II	1. Glyphosate
Q. aro A	2. Phosphinothricin
R hpt	3. Kanamycin
S. bar	4. Hygromycin B

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

Q.17 Determine the correctness or otherwise of the following **Assertion [a]** and **Reason [r]**
Assertion: Enzymatic method of tissue dispersion is milder than chemical and mechanical methods.
Reason: Enzymes work at optimal temperature and pH

(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.18 Match each parameter in group 1 with the appropriate measuring device in group 2

Group 1	Group 2
P. Pressure	1. Photometer
Q. Foam	2. Rotameter
R. Turbidity	3. Diaphragm gauge
S. Flow rate	4. Rubber sheathed electrode

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

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Q.19 Main functions of baffles in a bioreactor are
(P) to prevent a vortex
(Q) to increase aeration
(R) to reduce interfacial area of oxygen transfer
(S) to reduce aeration rate

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

Q.20 How many kilograms of ethanol is produced from 1 kilogram of glucose in ethanol fermentation ?

(A) 2.00 (B) 0.20 (C) 0.51 (D) 0.05

Q.21 Meristems escape virus invasion because

(A) vascular system is absent in the meristem
(B) of low metabolic activity in the meristem
(C) the 'virus inactivating system' has low activity in the meristem
(D) of low endogenous auxin level

Q.22 Downstream processing of an industrial process yielded a highly purified bioactive protein. This protein was subjected to cleavage by trypsin. Chromatographic separation of products resulted in 4 peptides (P, Q, R, S) with the following amino acid sequences
(P) phe-val-met-val-arg
(Q) ala-ala-try-gly-lys
(R) val-phe-met-ala-gly-lys
(S) phe-gly-try-ser-thr

Chemical cleavage of the same protein with cyanogenbromide and chromatographic separation resulted in three peptides (i, ii, iii) with the following sequences
(i) ala-gly-lys-phe-gly-try-ser-thr
(ii) ala-ala-pry-gly-lys-phe-val-met
(iii) val-arg-val-phe-met

The order of the peptides that gives the primary structure of the original protein is

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

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Common Data for Questions 23, 24:
Enzyme X converts substrates S_1 and S_2 (which are similar but not identical) to products P_1 and P_2, respectively

Q.23 K_m values of enzyme X for substrate S_1 and S_2 are 0.1 mM and 0.01 mM, respectively. This suggest that
(P) enzyme X has more affinity towards S_1
(Q) enzyme X has low affinity towards S_1
(R) enzyme X has more affinity towards S2
(S) enzyme X has low affinity towards S2

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

Q.24 What would happen if enzyme X is incubated with a mixture of 0.1 mM of S_1 and S_2 ?

(A) Products P_1 and P_2 are produced at equal concentrations
(B) Only product P_2 is produced
(C) More P_2 and less P_1 are produced
(D) More P_1 and less P_2 are produced

Linked Answer Questions: Q. 25 to Q. 28 carry two marks each.

Statement for Linked Answer Questions 25 & 26:
In a Fed-batch culture glucose solution is added with a flow rate of 2 m^3/day. The initial volume of the culture is 6 m^3.

Q.25 The volume of culture at the end of second day (neglect loss due to vaporization) is

(A) 6 m^3 (B) 8 m^3 (C) 10 m^3 (D) 12 m^3

Q.26 What would be the dilution rate of the system at the end of second day ?

(A) 2.00 (B) 0.20 (C) 0.02 (D) 0.01

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Statement for Linked Answer Questions 27 & 28:

Absence of cellulosic cell wall, high β-carotene content and GRAS status make *Dunaliella salina* a good model system for producing edible vaccines. 10^9 Cells of *D. salina* were electroporated with a high expression DNA vector containing an antigenic gene.

Q.27 If 10^3 cells survived after electroporation, how many cells were killed during this process (round of to the nearest number) ?

(A) 10^9 (B) 10^8 (C) 10^6 (D) 10^5

Q.28 The antigen is expressed as transmembrane protein with a single epitope on its extracellular domain. The cells that survived (assume 100% transfection and expression of protein) were incubated with a radio labeled Fab fragment (specific activity: 100 cpm/picomole) against this epitope. After washing, the cell pellet has 1000 cpm. The average number of epitopes present on a single recombinant alga are

(A) 6×10^9 (B) 1×10^9 (C) 6×10^3 (D) 1×10^6

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Q. 1 – Q. 6 carry one mark each.

Q.1 Availability of free energy is maximum in which of the following trophic levels?

(A) Producers
(B) Decomposers
(C) Herbivores
(D) Secondary consumers

Q.2 From the given statements identify the *INCORRECT* one.

(A) GA involves in flowering
(B) Ethylene is produced during ripening of the seeds
(C) Auxin helps in cell elongation and formation cf root
(D) Cytokinin helps in embryo development and prevent leaf senescence

Q.3 The correct equation for the reduction of nicotinamide adenine dinucleotide phosphate is

(A) $NADP^+ + 2H^+ \rightarrow NADPH^+ + H^+$
(B) $NADP^+ + H^+ + e^- \rightarrow NADPH$
(C) $NADP^+ + H^+ + 2e^- \rightarrow NADPH$
(D) $NADP^+ + 2H^+ + 2e^- \rightarrow NADPH_2$

Q.4 Which of the following factors is critical for haploidy induction?

(A) Presence of optimum levels of auxin and cytokinin in the medium
(B) Treatment of donor plants with phytohormones
(C) Use of colchicine in the medium
(D) Induction and proliferation of callus from anther culture

Q.5 Gene transfer method: Choose the correct answer.

(A) *Agrobacterium*-mediated transformation was developed by E. C. Cocking
(B) Biolistic transformation was first developed by J. C. Sanford
(C) Protoplast transformation was first reported by I. Potrykus
(D) Pollen tube transformation was demonstrated by Oifa Zhang

Q.6 Identify the mismatch tissue.

(A) Periderm
(B) Phelloderm
(C) Phellem
(D) Pallisade

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Q.7 Find out the correct statements for Linnaeus system of classification.

P It is also known as artificial-sexual system of classification
Q It was published in the name of "*Genera Plantarum*"
R In this system plants belonging to widely distant natural groups are placed under one order of a class
S In this system Gymnospermae and Angiospermae are placed in two taxa of equal ranks

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

Q.8 Which of the following statements are true in case of fluid-mosaic model cell membranes.

P Between 5-8 nm thick and appear trilaminar when viewed in cross section under electron microscope
Q Less than 1 nm thick and consist of a layer of protein sandwitched between two layers of phospholipids
R In the lipid bilayer, proteins are embedded at irregular intervals and held by hydrophilic interactions between lipids and hydrophilic domains of the proteins
S The protein domains exposed on one side of the lipid bilayer are different from those exposed on the other side

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

Q.9 Identify the correct statements.

P Bundle sheath containing chloroplast present in C_4 plants
Q Annual rings differentiate into barks and woods
R Sap wood is important for biological functions and heart wood is economically important as it contains gums, resins, oils, tannins, etc.
S Clonal propagation leads to somaclonal variation

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

Q.10 Which of the following statements are true on ecological point of view?

P 'Pyramid of numbers' can sometimes be inverted
Q Standing crop is not a reliable measure of productivity
R Primary productivity should always be calculated on dry matter rather than on fresh biomass
S The total solar energy trapped in the food material by photosynthesis is referred to as net primary production

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

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Q.11 Identify the wheat disease based on the following given symptoms.

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- The disease appears when the ears emerges in plants
- Diseased ears emerges out of the boot leaf a little earlier than the healthy ones
- Black powdery mass of spores replace the flowers
- The growth of the plant and its general appearance is not affected

(A) Loose smut of wheat
(B) Flag smut of wheat
(C) Black rust of wheat
(D) Powdery mildew of wheat

Q.12 Identify the correct statements from the following with respect to improvement of shelf-life of fruits and vegetables.

P It should be cooled immediately to slow down the respiration process
Q The air of the store chamber should pass through charcoal to absorb the ethylene produced during the ripening process
R It should be treated immediately with silver nitrate and cobalt chloride
S It should be treated with the low concentration of biotin and nicotinic acid for prolonged preservation

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

Q.13 Heterosis helps in crop improvement. Identify the correct statements.

P Parental lines improvement by diversification of *cms* and restorer sources for higher yield
Q Development of fortified food to satisfy market demand
R Improved hybrid crop developed for dual function – salinity tolerance and fungal resistance
S Reciprocal crosses of an improved isogenic line for a better yield

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

Q.14 Identify the correct statements.

P Xylogenesis is defined as the differentiation of parenchyma into specialized xylary cell
Q First anther culture was reported by Guha and Maheshwari
R Totipotency was reported by Sundarland
S *In vitro* fertilization reported by Hofmeister

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

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Q.15 Encapsulated somatic embryo in alginate beads produce artificial seeds. Identify the correct statements.

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P Artificial seed is a genetically modified agricultural product
Q Artificial seed is a patented product for pharmaceutical industry
R Artificial seeds can be stored and transferred to soil for germination
S Somatic embryo of single cell origin produce genetically uniform plants

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

Q. 16-22 are matching exercises.
Choose the correct one from the alternatives A, B, C and D.

Q.16

Group I (Name of the Fungus)	Group II (Class)
P *Agaricus sp.*	1. Ascomycetes
Q *Pilobolus sp.*	2. Deuteromycetes
R *Neurospora sp.*	3. Phycomycetes
S *Rhizoctonia sp.*	4. Actinomycetes
	5. Basidiomycetes
	6. Zygomycetes

(A)	(B)	(C)	(D)
P - 5	P - 4	P - 5	P - 6
Q - 4	Q - 1	Q - 3	Q - 1
R - 3	R - 2	R - 1	R - 3
S - 1	S - 6	S - 2	S - 5

Q.17

Group I (Biological activity)	Group II (Chemical compound)
P Antibacterial and antifungal	1. Hypericin
Q Antibacterial not antifungal	2. Aspergillic acid
R Antifungal not antibacterial	3. Fulvic acid
S Antiviral	4. Ustalagic acid
	5. Abscisic acid
	6. Terramycin

(A)	(B)	(C)	(D)
P - 1	P - 2	P - 2	P - 5
Q - 2	Q - 6	Q - 1	Q - 6
R - 3	R - 4	R - 5	R - 1
S - 4	S - 1	S - 6	S - 2

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Q.18 **Group I (Common name)**

P Garden bean
Q Oat
R Cashew nut
S Carrot

Group II (Scientific name)

1. *Raphanus sativus*
2. *Phaseolus vulgaris*
3. *Brassica oleracea*
4. *Anacardium occidentale*
5. *Daucus carota*
6. *Avena sativa*

(A)	(B)	(C)	(D)
P - 2	P - 6	P - 1	P - 2
Q - 6	Q - 2	Q - 3	Q - 1
R - 4	R - 4	R - 6	R - 6
S - 5	S - 5	S - 4	S - 4

Q.19 **Group I**

P Insect resistant cotton
Q Golden rice
R 'Flavr-Savr' tomato
S Herbicide tolerant soyabean

Group II

1. Bt
2. Round up
3. 2,4-D
4. Carotenoids
5. Ferritin
6. ACC-deaminase

(A)	(B)	(C)	(D)
P - 2	P - 1	P - 1	P - 2
Q - 5	Q - 4	Q - 4	Q - 4
R - 1	R - 6	R - 6	R - 6
S - 3	S - 2	S - 3	S - 1

Q.20 **Group I**

P Funiculus
Q Seed coat dormancy
R Reserve food stored in endosperm
S Vivipary germination

Group II

1. Pea pod
2. Coconut
3. Rice seed
4. *Erycibe*
5. Malvaceae
6. *Rhizophora*

(A)	(B)	(C)	(D)
P - 1	P - 1	P - 1	P - 1
Q - 4	Q - 6	Q - 5	Q - 2
R - 3	R - 5	R - 3	R - 6
S - 5	S - 4	S - 6	S - 3

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Q.21 **Group I**

P Chromosome cycle
Q G_1 phase
R Salt glands
S Tunica-corpus

Group II

1. Interval between mitosis and DNA replication
2. Helps in removing the excess salts
3. Behavior of the cell as they grow and divide
4. Organization of apical meristem based on a single apical cell
5. Concept of tissue differentiation at shoot apical meristem
6. Replication and partitioning of the genome into two daughter cells

(A)
P - 1
Q - 6
R - 3
S - 4

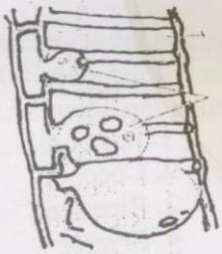
(B)
P - 2
Q - 1
R - 6
S - 5

(C)
P - 3
Q - 6
R - 4
S - 5

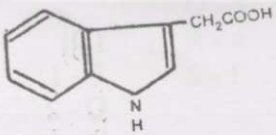
(D)
P - 6
Q - 1
R - 2
S - 5

Q.22 **Group I**

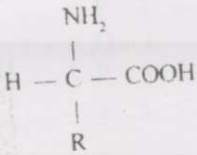
(P)



(Q)



(R)



(S)

Group II

1. Amino acid
2. Glucose
3. IAA
4. Bulliform cells
5. Tyloses
6. Kinetin

(A)
P - 5
Q - 4
R - 6
S - 3

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

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

(D)
P - 4
Q - 5
R - 3
S - 6

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Common Data for Questions 23, 24:
A researcher studied three independently assorting genes in a plant. Each gene has a dominant and a recessive allele. T: tall plant, t: dwarf plant; W: purple flower, w: white flower; C: full pods, c: constricted pods. A cross was conducted between

TTWWCC x tt ww cc

Q.23 How many different kinds of F_1 gamates would be expected from the above cross?

(A) 2 (B) 4 (C) 8 (D) 16

Q.24 How many different kinds of F_2 genotypes would be expected from the above cross?

(A) 8 (B) 9 (C) 16 (D) 27

Linked Answer Questions: Q. 25 to Q. 28 carry two marks each.

Statement for Linked Answer Questions 25 & 26:
Enzyme [E] reacts with substrate [S] to form an [ES] complex at normal temperature to produce the product. In the presence of inhibitor the rate of reaction changes.

Q.25 Which of the following statements are **INCORRECT** about enzyme-mediated reaction in presence of inhibitor?

P Competitive inhibition causes rise in K_m value without altering V_{max}
Q Noncompetitive inhibition causes decrease in V_{max} and rise in K_m
R Uncompetitive inhibition causes decrease in V_{max} without altering K_m
S Uncompetitive inhibition is rare and causes a decrease in both V_{max} and K_m

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

Q.26 Identify the correct expression for noncompetitive and competitive inhibition.

	Slope	Intercept on ordinate
P	K_m/V_{max} $(1+I/K_i)$	$1/V_{max}$ $(1+I/K_i)$
Q	K_m/V_{max} $(1+I/K_i)$	$1/V_{max}$
R	K_m/V_{max}	$1/V_{max}$ $(1+I/K_i)$
S	K_m/V_{max}	$1/V_{max}$

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

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Statement for Linked Answer Questions 27 & 28:
Economically important plants are known for their commercial products and recognized with scientific names.

Q.27 From the given common names, identify sequentially the scientific names of the following plants.

Common names: Cotton, Peanut, Sarpagandha and Tea

P *Camellia sinensis*
Q *Arachis hypogea*
R *Rauwolfia serpentina*
S *Gossypium arboreum*

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

Q.28 Identify the most important commercial products from the above mentioned plants. (Follow the sequence of the common names)

P Vegetable Oil
Q Fibre
R Alkaloid
S Beverage

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

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Q. 1 – Q. 6 carry one mark each.

Q.1 Reverse transcriptase used in genetic engineering was discovered by

(A) Temin & Baltimore
(B) Smith & Arber
(C) Smith & Baltimore
(D) Temin & Arber

Q.2 Infection of *E.coli* by bacteriophage λ is normally detected by

(A) Resistance of the bacteria to an antibiotic
(B) Growth of single colony on the agar plate
(C) The appearance of plaques or lysed bacteria on agar plates
(D) Restriction digest of the bacterial DNA

Q.3 A microscope that has a total magnification of 1500X with an oil immersion lens has an ocular of power

(A) 1.5X (B) 15X (C) 150X (D) 1500X

Q.4 Which of the following species shows a high resistance to radiation damage?

(A) *Deinococcus* (B) *Micrococcus* (C) *Staphylococcus* (D) *Planococcus*

Q.5 Peptic ulcers are caused by

(A) *Shigella sonei*
(B) *Giardia lambia*
(C) *Enterobius vermicularis*
(D) *Helicobacter pylori*

Q.6 The evolutionary history of an organism is called

(A) Taxonomy (B) Dendrogram (C) Phylogeny (D) Cladogram

Q. 7 – Q. 24 carry two marks each.

Q.7 Which vector would be the most appropriate for cloning a 150 kb fragment of DNA?

(A) pBR322 (B) λ vector (C) YAC (D) BAC

Q.8 Which group of microorganisms have a high level of unsaturated fatty acids in their cell membrane?

(A) Mesophilic
(B) Psychrophilic
(C) Thermophilic
(D) Hyperthermophilic

Q.9 Complete denitrification of nitrate results in the formation of

(A) N_2 (B) NH_3 (C) N_2O_5 (D) NH_2OH

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Q.10 Which of the following disease is **NOT** caused by the *Coxsackie* virus?

(A) Intestinal infection
(B) Meningitis
(C) Gingivitis
(D) Myocarditis

Q.11 Bacterial cell wall biosynthesis is inhibited by the antibiotic

(A) Vancomycin
(B) Tetracycline
(C) Chloramphenicol
(D) Erythromycin

Q.12 Match the correct combination of plasmid DNA to their properties

Plasmid DNA	**Property**
(P) Conjugative plasmid	(1) can integrate into the chromosome and replicate when the chromosome is copied
(Q) Cryptic plasmid	(2) capable of transferring itself between prokaryotes
(R) Episome	(3) Does not appear to have any function

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

Q.13 An Hfr bacterium is one that contains

(A) Many unusual plasmids
(B) Chromosomal material acquired from a recipient cell
(C) The ability to undergo transduction
(D) A plasmid integrated into its chromosome

Q.14 Match the following product/process to the microorganism involved

Product/Process	**Microorganism**
(P) Bioplastics	(1) *Beauveria bassiana*
(Q) Bioremediation	(2) *Thiobacillus thiooxidans*
(R) Bioleaching	(3) *Ralstonia eutropha*
(S) Biopesticide	(4) *Pseudomonas putida*

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

Q.15 Which of the following enzymes convert glucose-6-phosphate to 6-phosphoglucono-δ-lactone in the Entner-Doudoroff pathway?

(A) Glucose-6-phosphate dehydrogenase
(B) Phosphoglucoisomerase
(C) Phosphoglucolactonase
(D) 6-phosphogluconate dehydrase

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Q.16 The process in which a molecule is transported into the cell while being chemically **altered** is called

(A) Passive transport
(B) Group translocation
(C) Facilitated transport
(D) None of the above

Q.17 MacConkey agar is a type of

(A) Selective media
(B) Differential media
(C) Both selective & differential media
(D) None of these

Q.18 Which of the following modes of DNA replication are used by bacteria?

(A) Rolling circle
(B) Theta replication
(C) Bidirectional replication
(D) All of the above

Q.19 Which of the following is **INCORRECT** about negative staining procedure?

(A) It utilizes a stain such as Nigrosin
(B) Microorganisms stain deeply
(C) Microorganisms repel the dye
(D) An acidic dye is used

Q.20 A mutation in the codon **UCG** to **UAG** is described as

(A) Nonsense mutation
(B) Silent mutation
(C) Mis-sense mutation
(D) Neutral mutation

Q.21 The ineffectiveness of many antibiotics today is closely associated with

(A) Bacteriophages
(B) F plasmids
(C) R plasmids
(D) Bacterial transformations

Q.22 Which type of cells actually secrete antibodies?

(A) T cells (B) Macrophages (C) Monocytes (D) Plasma cells

Common Data Questions

Common Data for Questions 23, 24:
The 50μL of competent *E.coli* cells (10^9 CFU/mL) were transformed using 0.5ng of a 5kb plasmid DNA to which 950μL of SOC medium was added. Only 50 μL of this was plated on a selective agar plate. After an 12h incubation at 37°C, 90 colonies were observed

Q.23 Calculate the efficiency of this transformation in CFU/μg of DNA

(A) 3.6×10^5 (B) 3.6×10^6 (C) 1.8×10^5 (D) 1.8×10^6

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Q.24 Calculate the percentage of transformed cells

(A) 0.36% (B) 0.72% (C) 3.6% (D) 7.2%

Linked Answer Questions: Q. 25 to Q. 28 carry two marks each.

Statement for Linked Answer Questions 25 & 26:
An egg sandwich got contaminated with 10 cells of a bacterium. It was left open at 37°C for 4 hours. It was found to contain 40960 cells.

Q.25 What is the generation time of this bacterium?

(A) 15 min (B) 20 min (C) 25 min (D) 30 min

Q.26 If the initial inoculum was only 1 cell, then after 10 hours what will be the number of cells?

(A) 2^{20} (B) 2^{24} (C) 2^{30} (D) 2^{40}

Statement for Linked Answer Questions 27 & 28:
A researcher desires to clone a gene (1kb) of a microorganism. Its genome size is 1.5×10^4 kb. The average size of its library fragment is 5kb.

Q.27 What is the ratio of genome size of the microorganism relative to average size of the fragment in the gene library?

(A) 3000 (B) 1500 (C) 45000 (D) None of these

Q.28 The genomic library was created in vectors that were transformed into bacterial cells. If there is a 95% probability of the transformation, how many recombinant bacterial colonies will have to be screened to find this particular gene?

(A) 7000 (B) 8000 (C) 9000 (D) 10000

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Q. 1 – Q. 6 carry one mark each.

Q.1 Sickle-cell anemia is caused by mutation in

(A) Haemoglobin A
(B) Haemoglobin B
(C) Haemoglobin F
(D) Haemoglobin S

Q.2 Each individual antigenic determinant of the variable region of the antibody is referred to as

(A) Paratope
(B) Epitope
(C) Agretope
(D) Idiotope

Q.3 Which of the following non covalent interactions is considered as strongest ?

(A) Hydrophobic interactions
(B) Ionic bonds
(C) Hydrogen bonds
(D) Van der waals forces

Q.4 Acrosome present on the sperm head is derived from

(A) Golgi apparatus
(B) Nucleus
(C) Endoplasmic reticulum
(D) Centrosome

Q.5 The first site of hematopoiesis in the mouse embryo is

(A) Liver
(B) Bone marrow
(C) Spleen
(D) Yolk sac

Q.6 Which of the following fish is considered to be a 'living fossil' ?

(A) *Protopterus*
(B) *Lepidosiren*
(C) *Latimeria*
(D) *Neoceratodus*

Q. 7 – Q. 24 carry two marks each.

Q.7 Albinism is controlled by a recessive gene (c). From a marriage between a normal pigmented person carrying genotype Cc and albino cc, what is the chance that an albino child will be born ?

(A)1/2
(B)1/4
(C)3/4
(D)3/8

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Q.8 Many fishes are able to live outside water with the help of special air chambers above the gills. Which one of the following fish does not have same adaptation?-

(A) *Anabas*
(B) *Saccobranchus*
(C) *Gobius*
(D) *Clarias*

Q.9 The air sac plays an important role in the aerial life of flying birds. Which of the following is not a function of the air sac ?

(A) As a resonator
(B) As a balloon
(C) In perching
(D) Regulator of moisture content of the body

Q.10 Transgenic mice are produced by

(A) *In vitro* fertilization of ova by sperms from a different strain followed by implantation
(B) Transfer of cloned foreign DNA into blastocyst cells followed by implantation
(C) Implantation of mixed blastocyst cells from two different strains
(D) Selection of a given trait by repeated back-crossing

Q.11 Which of the following proteins binds tightly to DNA in the chromatin structure and influences eukaryotic DNA replication ?

(A) Histones
(B) Lamins
(C) Vimentin
(D) Proteasome

Q.12 During DNA replication significant proportion of newly synthesized DNA in the lagging strand exists as small Okazaki fragments. The sizes of these units in bacteria are approximately

(A) 100 nucleotides
(B) 1000 nucleotides
(C) 100 base pairs
(D) 1000 base pairs

Q.13 Which of the following statement is not included in the inductions and deductions of Darwinism ?

(A) The prodigality or reproduction is very important since over crowdedness results in struggle for existence
(B) In the struggle for existence the organisms with variation in structure habits or instincts may be better adapted to new conditions and will have better chance of survival
(C) Natural selection operates amongst the fittest and the new forms are established leading to speciation.
(D) There is no organism without genotype. The genotype should be changed to give an efficient organism.

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Q.14 In case of turtles, the temperature at which the eggs are exposed during development is the deciding factor in sex determination. This is because of the temperature sensitivity of

(A) Estrogen
(B) Testosterone
(C) Aromatase enzyme
(D) Progesterone

Q.15 One of the most remarkable features of evolution is the formation of the amnion and the allantoin, which appeared for the first time in

(A) Amphibians
(B) Fishes
(C) Birds
(D) Reptiles

Q.16 For cloning an animal, which of the following somatic cells would not be suitable ?

(A) Lymphocytes
(B) Fibroblasts
(C) Epidermal cell
(D) Neutrophils

Q.17 Differential blood cell counting is carried out routinely not only for assessing the 'general health' of an individual but also for identifying types of infection. Increase in the circulatory eosinophils is likely to be due to infection with

(A) Viruses
(B) Helminths
(C) Fungus
(D) Bacteria

Q.18 Rajesh and Deb while playing in the field got stung by a comparable number of bees. After about 15 minutes, while Rajesh experienced only pain and small swelling, Deb manifested intense swelling, breathlessness and had to be hospitalized. Which of the following reasons would be the most logical explanation for the different reactions ?

(A) Deb was on an empty stomach
(B) Rajesh is several years younger than Deb
(C) Deb had been stung by bees before
(D) Deb is several years younger than Rajesh

Q.19 Normally receptors are cell-membrane bound but with few exceptions. Which of the following receptors is present in the cytoplasm ?

(A)Thyroid stimulating hormone receptor
(B) Epidermal growth factor receptor
(C) Progesterone receptor
(D) Cytokine receptor

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Q.20 During development of the red blood cells from the stem cells of most mammals, the phenomenon of enucleation is observed during the last stage of differentiation. However, the red blood cells of some animals are nucleated:
Identify which one of the following ?

(A) Cow (B) Rhinoceros

(C) Camel (D) Polar bear

Q.21 Comparison of the genome sequences of any two animals would reveal evolutionary relatedness. In this context, the similarity between man and chimpanzee is

(A) > 95 % (B) < 75 %

(C) < 25 % (D) < 50%

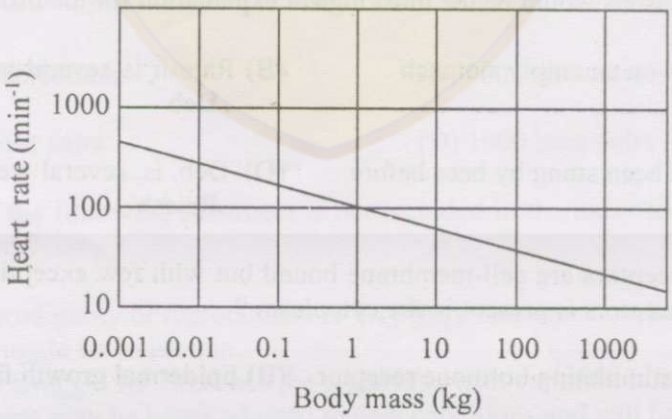
Q.22 Certain types of cancers can be correlated with specific changes in chromosome structure. In patients suffering from myelogenous leukemia, the abnormal chromosome detected was termed Philadelphia chromosome. Which of the following chromosome is altered in this disease ?

(A) Chromosome 10 (B) Chromosome 11

(C) Chromosome 20 (D) Chromosome 22

Common Data Questions

Common Data for Questions 23, 24:
The size of mammalian heart is nearly proportional to body size and makes up approximately 0.59 % of the body mass. However the heart rate is inversely related to body size. The following graph represents the relationship between the heart rate and body size of the mammals (data are plotted on logarithmic coordinates).



Q.23 1 kg bird is expected to have a heart of 8.2 g. For a mammal of the same size, the expected size of the heart could be

(A) 11.8 g (B) 5.9 g

(C) 2.95 g (D) 23.6 g

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Q.24 An elephant that weighs 3000 kg has a resting pulse rate of 25 per minute. What would be the possible range of the pulse rate of 3 g shrew (the smallest living mammal) ?

(A) 25 (B) 125

(C) 250 (D) Above 500

Linked Answer Questions: Q. 25 to Q. 28 carry two marks each.

Statement for Linked Answer Questions 25 & 26:

An experiment was carried out to study the immune response to dust mite allergen in two strains of mice viz., BALB/c (b) and Nude (n). The mice were administered the immunogen on days 0 and 8 and allergen specific circulatory antibodies were monitored in the two groups of mice on days 7 and 18.

Q.25 Which of the following class of antibodies would be detected in these strains of mice on day 7 ?

(A) IgM (b) IgM (n) (B) IgG (b) IgM (n)

(C) IgA (b) IgM (n) (D) IgE (b) IgM (n)

Q.26 Which of the following class of antibodies would be detected in the two strains of mice on day 18 ?

(A) IgG (b) IgM (n) (B) IgE (b) IgE (n)

(C) IgE (b) IgE (n) (D) IgE (b) IgG (n)

Statement for Linked Answer Questions 27 & 28:

A woman has a rare abnormality of the eye that has been found to be dependent on a single dominant gene (P). The woman's father had abnormal eyes but mother had normal eyes.

Q.27 If the woman marries a man with normal eyes, what proportion of her children will have abnormal eyes ?

(A) 25 % (B) 50 %

(C) 75 % (D) 100 %

Q.28 Which of the following representation does not explain the genotype of the woman's father ?

(A) Heterozygous for P (B) Homozygous for P

(C) Dominant for P (D) Recessive for P

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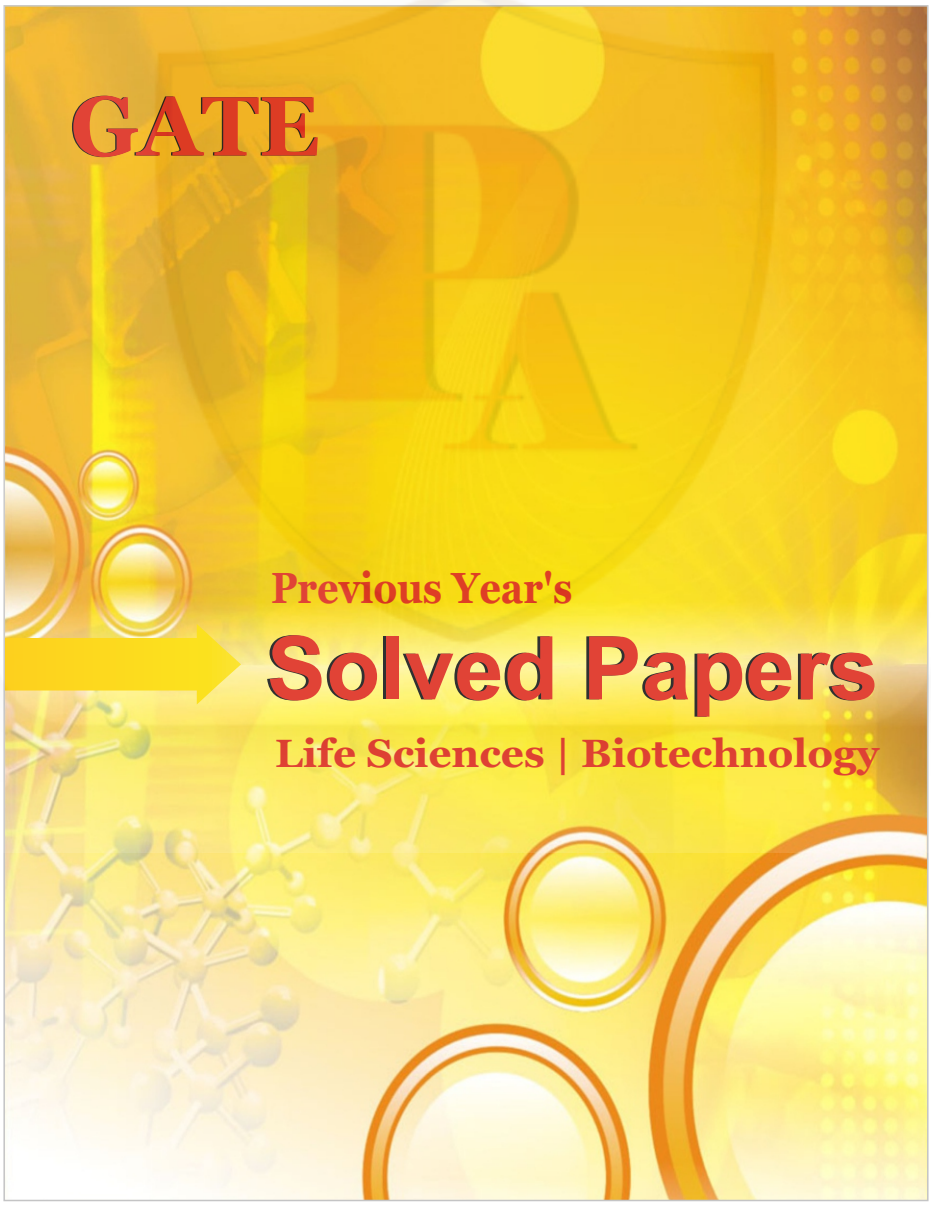
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