LIFE SCIENCES

J: CHEMISTRY (COMPULSORY)

ONE MARKS QUESTIONS (1-6)

1. Which of the following will NOT conduct electricity?
   a. Solid metallic Na
   b. Solid NaCl
   c. Aqueous NaCl
   d. Fused NaCl

2. The region in which the following spectral lines are observed is
   P. Lyman series
   Q. Balmer series
   R. Paschen series
   a. P - UV, Q - UV/Vi, R – ZR
   b. P -UV/Vis, Q UV, R- IR
   c. P - TR, Q - UV, R - Vis/IR
   d. P - UV, Q - ZR, R - UV/Vis

3. The pH of a 10^{-8} molar hydrochloric acid solution is
   a. exactly 8
   b. between 7 and 8
   c. exactly 7
   d. between 6 and 7

4. The plot of concentration of A against time is a straight line with negative slope for the reaction:
   $A \rightarrow$ products
   a. -1
   b. 0
   c. 1
   d. 2

5. Among the following four amines, which one is least basic in aqueous solution?
   a. CH_3NH_2
   b. $(CH_3)_2NH$
   c. $(CH_3)_3N$
   d. $CH_3NHC_6H_5$

6. Which of the following acids is used for the preparation of cyclohexene from cyclohexanol?
   a. Conc. HNO_3
   b. 48% BBr
   c. 85% H_3PO_4
   d. $(COOH)_2$

TWO MARKS QUESTIONS (7-24)

7. An aqueous mixture solution is prepared which contains 0.1 M of KCl and 0.1 M KI. To this solution, a drop of 0.01 M aqueous solution of $AgNO_3$ is added.
   Which of the following statement is correct?
   a. A precipitate forms which is primarily AgI.
   b. A precipitate forms which is primarily AgCl.
   c. A precipitate forms which has equimolar, mounts of AgCl and AgI
   d. There will be no precipitation, as there is no common ion between potassium and silver salts.

8. 1g L^{-1} solution of a protein exerts an osmotic pressure of 8.3×10^{-3} bar at 300 K. Calculate the molar mass of the protein.
   a. 2490 g mol^{-1}
   b. 3000 g mol^{-1}
   c. 4578 g mol^{-1}
   d. 6100 g mol^{-1}

9. An electrochemical cell of the following representation was found to be a galvanic cell, where 'A' and 'B' represent different metals.
   $A (s) |A^{2+} (aq) \ 1 M|| B^{2+} (aq) 1M| B(s)$
   Which of the following statements with respect to the cell is correct?
   a. The cell converts electrical energy to chemical energy spontaneously.

b. The cell uses electrical energy to deposit 'A' and dissolve 'B' spontaneously.

c. (A^{2+}/A) is a stronger reducing agent than (B^{2+}/B)

d. (A^{2+}/A) is a stronger oxidizing agent than (B^{2+}/B).

10. For a first order reaction at a particular temperature, the half-life was found to be $(100 \ln 2)$ seconds. The specific rate constant of the reaction is
   a. 0.01 s^{-1}
   b. 100 s^{-1}
   c. 230 s^{-1}
   d. 693 s^{-1}

11. Liquid bromine boils at 59 °C. Assuming it to be a normal liquid, which of the following gives its standard molar enthalpy of vaporization?
   a. $(8.314 \times 332) \text{ J mol}^{-1}$
   b. $(85 \times 332) \text{ J mol}^{-1}$
   c. $(332 / 85) \text{ J mol}^{-1}$
   d. $(332 / 8.314) \text{ J mol}^{-1}$

12. The limiting molar conductivities of some species are given in $(\text{S cm}^2 \text{ mol}^{-1})$ units:
   $\Lambda°(HCl) = 425.9$; $\Lambda°(NaCl) = 126.4$; $\lambda°(H) = 349.6$
   Find the limiting molar conductivity of Na ion
   a. 50.1
   b. 76.3
   c. 299.5
   d. 476.0

13. The reactivity order for nitration of benzene, chlorobenzene, phenol and nitrobenzene is
   a. Benzene > Chlorobenzene > Phenol> Nitrobenzene
   b. Phenol > Benzene> Chlorobenzene> Nitrobenzene
   c. Nitrobenzene > Phenol> Chlorobenzene > Benzene
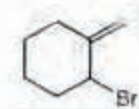   d. Phenol> Chlorobenzene> Benzene > Nitrobenzene

14.
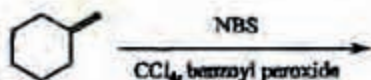
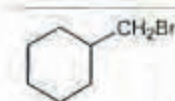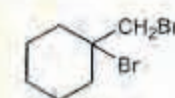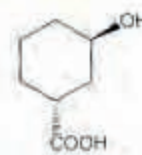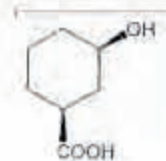The major product in the above reaction is
   a.
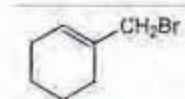
b.

c.

d.

15. When a compound (M) is slowly heated with chloroform in alcoholic KOH solution, it produces an offensive smell. The compound M is
   a. N,N-Diethylaniline
   b. Diethylamine
   c. Ethylamine
   d. Triethylamine

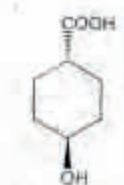16. Which one of the following will lactonize in presence of acid?
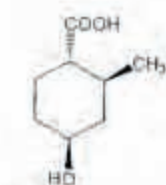   a.

   b.

   c.

   d.

17. The major condensation product in the reaction of benzaldehyde with excess amount of acetone in presence of dilute NaOH solution is
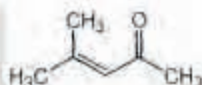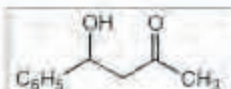
a.

C_6H_5—CH=CH—C(=O)—CH_3

b.

c.

C_6H_5—CH=CH—C(=O)—CH=CH—C_6H_5

d.

H_3C—C(CH_3)=CH—C(=O)—CH_3

e.

C_6H_5—CH(OH)—CH_2—C(=O)—CH_3

18. Ammonia gas can be dried over
   a. conc. H_2SO_4
   b. anhydrous P_2O_5
   c. anhydrous CaO
   d. anhydrous $CaCl_2$

19. Which of the following molecules will have zero dipole moment?
   H_2O, $SiCl_4$, CO_2, NH_3, BF_3
   a. H_2O, $SiCl_4$, BF_3
   b. CO_2, NH_3, $SiCl_4$
   c. H_2O, NH_3, BF_3
   d. CO_2, BF_3, $SiCl_4$

20. Which of the following pairs of complexes will NOT show any ligand field d-d transitions?
   a. $K_4Fe(CN)_6$], $[Ni(H_2O)_2(NH_3)_4]SO_4$
   b. $[Cu(CH_3CN)_4]Cl$, $Na_3[CoCl_2(CN)_4]$
   c. $[Cu(CH_3CN)_4]Cl$, $[Zn(NH_3)_4Cl_2]$
   d. $[Cu(H_2O)_2(NH_3)_4]Cl_2$, $[Zn(H_2O)_4(NH_3)_4]SO_4$

21. Which of the following substances will produce acidic oxides when burnt in excess air? Sodium (P), Sulfur (Q) and Methane (R)
   a. All three
   b. Both Q and R
   c. Only Q
   d. Both P and R

22. In the ring test for nitrate ion, the brown color is due to the formation of
   a. $[Fe(H_2O)_5(NO)]SO_4$
   b. $[Fe(H_2O)_5(NO_2)]SO_4$
   c. $[Fe(H_2O)_4(NO)_3]SO_4$
   d. $[Fe(H_2O)_5(NO_3)]SO_4$

Common Data Questions

Common Data for Questions 23 and 24:

The compound (N) on treatment with the reagent (0) gives an alkene.
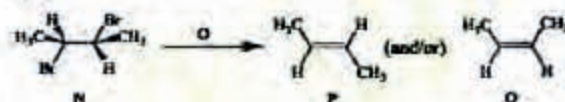
23. The appropriate reagent (O) required for this transformation is
   a. KOH / EtOH
   b. NaOMe / MeOH
   c. NaI / Acetone
   d. $NaNH_2$

24. The alkene will be produced as
   a. P exclusively since it is going through E2 mechanism
   b. Q exclusively since it is going through E2 mechanism
   c. Equal amount of P and Q since it is going through E1 mechanism
   d. P as major amount since it is going through E1cB mechanism

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

Statement for Linked Answer Questions 25 and 26:

$CuSO_4$ solution when treated with aqueous alkali (W) forms a blue precipitate (X), which dissolves on addition of excess W. Another aqueous alkali (Y) precipitates blue solid (1) when reacted with $CuSO_4$, but the blue precipitate (Z) does not dissolve with excess alkali (Y).

25. Identify W and X
   a. NH_4OH and $Cu(OH)_2$.$CuSO_4$
   b. NH_4OH and $Cu(OH)_2$
   c. NaOH and $Cu(OH)_2$.$CuSO_4$
   d. NaOH and $Cu(OH)_2$

26. Identify Y and Z

a. NH_4OH and $Cu(OH)_2.CuSO_4$
b. NH_4OH and $Cu(OH)_2$
c. NaOH and $Cu(OH)_2.CuSO_4$
d. NaOH and $Cu(OH)_2$

Statement for Linked Answer Questions 27 and 28:

For a first order reversible reaction

$$A \underset{k_b}{\overset{k_f}{\rightleftharpoons}} B$$

at a temperature T, the standard molar free energy (ΔG^o) is equal to -2.303RT, and the rate constant of forward reaction (k_f) is 1×10^{-3} s^{-1}.

27. The equilibrium constant of the reaction is
    a. 23.03
    b. 19.09
    c. 10
    d. 1

28. The rate constant of the backward reaction (k_b) is
    a. 5.26×10^{-5} s^{-1}
    b. 1×10^{-2} s^{-1}
    c. 4.35×10^{-5} s^{-1}
    d. 1×10^{-4} s^{-1}

K: BIOCHEMISTRY

ONE MARKS QUESTIONS (1-6)

1. Which of the following inhibitor uncouples electron transport and oxidative phosphorylation?
    a. Azide
    b. Dinitrophenol
    c. Oligomycin
    d. Rotenone

2. The catalytic efficiency of an enzyme is represented by
    a. V_{max}
    b. K_M
    c. k_{cat}
    d. k_{cat}/K_M

3. Which of the following activate protein kinase C?
    a. Inositol 1,4,5 -triphosphate
    b. Cyclic AMP
    c. Inositol
    d. Diacyiglycerol

4. Transcription initiation sites can be determined by
    a. Footprinting
    b. Northern blotting
    c. Primer extension
    d. Nick translation

5. One common feature between B and T cells is that
    a. both cells produce antibodies
    b. both cells possess MHC class II
    c. both B cell receptor and T cell receptor undergo rearrangement
    d. both cells can produce cytokines

6. In hybridoma technology, the myeloma cells used
    a. lack HGPRTase
    b. lack the ability to produce Ig
    c. lack both HGPRTase and ability to produce Ig
    d. lack thymidine kinase

TWO MARKS QUESTIONS (7-24)

7. Match the function in Column I with organelle in Column II
    Column I
    (P) Protein synthesis
    (Q) Protein degradation
    (R) Protein glycosylation
    Column II
    1. Endoplasmic reticulum
    2. Golgi body
    3. Lysosome
    4. Peroxisorne

	A	B	C	D
a.	P-3	P-1	P-1	P-4
b.	Q-2	Q-3	Q-4	Q-1
c.	R-1	R-2	R-3	R-2

8. Match the polysaccharides in Column I with their constituent monosaccharide in Column II
    Column I
    (P) Chitin
    (Q) Hemicellulose
    (R) Glycogen
    Column II

1. D-Glucose
2. N-Acetyl glucosamine
3. D-Xylose
4. D-Galactose

	(A)	(B)	(C)	(D)
a.	P-1	P-2	P-4	P-2
b.	Q-3	Q-4	Q-2	Q-3
c.	R-4	R-1	R-3	R-2

9. The T_m of phosphatidyl choline A is higher than T_m of phosphatidyl choline B because
   a. A has shorter chain fatty acid and more unsaturated fatty acid than B
   b. A has longer chain fatty acid and more saturated fatty acid than B
   c. A has shorter chain fatty acid than B
   d. A has more cis-unsaturated fatty acid that B

10. A mixture of proteins namely P, Q, R and S having molecular mass 50, 80, 120, and 150 KDa is applied on the Sephadex- G 200 column. The order of their elution will be
    a. P, Q, R, S
    b. S, R, Q, P
    c. Q, P, R, S
    d. P, Q, S, R

11. Match the transition state or chemical entity of each enzyme that is responsible for their catalytic function
    (P) Ribonuclease
    (Q) Lysozyme
    (R) Chymotrypsin
    (S) Carboxypeptidase
    1. Oxyanion
    2. Pentacovalent phosphorus
    3. Carbonium ion
    4. Mixed anhydride

	(A)	(B)	(C)	(D)
a.	P-3	P-2	P-2	P-4
b.	Q-2	Q-3	Q-1	Q-3
c.	R-4	R-1	R-3	R-2
d.	S-1	S-4	S-4	S-1

12. Match the function of following cofactors
    (P) Thiamine pyrophosphate
    (Q) Coenzyme A
    (R) Pyridoxal phosphate
    (S) Tetrahydrofolate
    1. Acyl group transfer
    2. Transfer of one carbon component
    3. Group transfer to / or from amino acid
    4. Aldehyde transfer

	(A)	(B)	(C)	(D)
a.	P-4	P-4	P-4	P-3
b.	Q-3	Q-3	Q-1	Q-1
c.	R-1	R-2	R-3	R-4
d.	S-2	S-1	S-2	S-2

13. Match the enzymes in Column I with their metabolic pathways in Column II.
    Column I
    (P) Succinyl Co A synthetase
    (Q) Acyl Co A dehydrogenase
    (R) Transketolase
    (S) Ribulose 1,5- bisphosphate carboxylase
    Column II
    1. β-Oxidation
    2. Calvin cycle
    3. Tricarboxylic acid cycle
    4. Pentose phosphate pathway

	(A)	(B)	(C)	(D)
a.	P-1	P-3	P-2	p-3
b.	Q-2	Q-1	Q-4	Q-1
c.	R-3	R-2	R-1	R-4
d.	S-4	S-4	S-3	S-2

14. Glycolysis and gluconeogenesis are reciprocally coordinated. Which of the following will activate pyruvate carboxylase in gluconeogenesis?
    a. Acetyl CoA
    b. Fructose 2,6 - bisphosphate
    c. ADP
    d. ATP

15. The atoms of pyrimidine ring are derived from
    (P) Carbamoyl phosphate
    (Q) Inosine mono phosphate
    (R) Aspartate
    (S) Glutamate
    a. PQ
    b. PR
    c. PS
    d. QR

16. Which of the following statements are true for steroid hormones?
    (P) increase the enzymatic activity of pre-existing target enzyme

(Q) act at cell nucleus

(R) interact with the plasma membrane receptors of target cells

(S) form a complex with receptor and acts as transcriptional enhancers

a. PR

b. QS

c. PQ

d. RS

17. Match the items on the left with the inhibitors on the right

(P) DNA polymerase α

(Q) RNA polymerase II

(R) Serine protease

1. Phenyl methyl sulphonyl fluoride (PMSF)

2. Aphidicolin

3. α amanitin

4. Actinomycin

	(A)	(B)	(C)	(D)
a.	P2	P-3	P-2	P-1
b.	Q-3	Q-1	Q-1	Q-2
c.	R-1	R-2	R-2	R-4

18. A nucleic acid sample is resistant to digestion with λ exonuclease. When heated it does not show typical melting curve of a linear double stranded DNA. On CsCl—ethidium bromide equilibrium density centrifugation it settles at the bottom of the centrifuge tube. The nucleic acid is

a. ccc pBR322

b. Bacteriophage P22 DNA

c. rRNA

d. RFIIM13 DNA

19. The following 4 different solutions are prepared by mixing the components of electron transport chain. Which among them is expected to cause a net transfer of electrons to cytochrome c?

a. Reduced ubiquinone and reduced cytochrome c.

b. Reduced ubiquinone, cytochrome b-c1 complex and reduced cytochrome c.

c. Oxidized ubiquinone and oxidized cytochrome c.

d. Reduced ubiquinone, cytocluome b-c, complex and oxidized cytochrome c.

20. Nucleated cells tends to be more resistant to complement mediated lysis than RBC because

a. many nucleated cells can endocytose the membrane attack complex

b. membrane attack complex cannot get inserted in the nucleated cell membrane

c. membrane attack complex can get inactivated by the nucleated cells

d. membrane attack complex get inactivated hence cannot get inserted in the nucleated cell membrane

21. In a fluorescein labeled antibody to μ heavy chain and rhodamine labeled antibody to δ heavy chain, the fluorescent antibody staining pattern of the progenitor B cells (Pro-B cells) will be

a. anti-μ staining in cyoplasm and on membrane

b. anti-μ and anti-δ staining in cytoplasm and on membrane

c. no cytoplasmic or membrane staining with either anti μ or δ antibody

d. anti-μ staining on the membrane

22. Serum IgM cannot activate the complement by itself because

a. it does not have complement binding site

b. it is planar in which complement binding sites in the Fe region are not accessible.

c. it gets degraded and hence unable to activate the complement

d. it needs metal ions to activate complement

Common Data Questions

Common Data for Questions 23 and 24:

A Caenorhabditis contig for one region of chromosome 2 contains contiguous locations marked 1, 2, 3, 4, 5, 6, 7, 8 and 9. Cosmid clones a, b, c, d and e overlap the locations 2-4, 3-5, 4-6, 5-8, 8-9 respectively. A cloned pBR322-x hybridize to cosmids b, c and d and pVC i8-y hybridize to cosmids d and e.

23. The approximate locations of x and y are

a. 4 and 7

b. 5 and 8

c. 4 and 8

d. 5 and 7

24. Both pBR322-x and pUCl8-y will hybridize to cosmids
    a. b
    b. d
    c. e
    d. c

Linked Answer Questions: Q.25 to Q.28 carry two marks each.
Statement for Linked Answer Question 25 and 26:
In animal cells concentration of sodium ions is higher outside the cell and less inside the cell, yet sodium does not enter the cells.

25. The cellular environment is maintained by generating a gradient and transporting the Na⁺ outside the cell through
    a. diffusion process
    b. passive transport via Na⁺-K⁺ pump
    c. active transport via Na⁺-K⁺ pump
    d. sodium ions not be transported

26. Digitoxigenin, a cardiotonic steroid that inhibits ATPase when applied on extra cellular face of membrane, helps in accumulation of Ca^{2+} inside the cardiac muscle cells by
    a. activating Na⁺-K⁺ pump and blocking Na⁺-Ca⁺⁺ exchanger
    b. inhibiting Na⁺-K⁺ pump and blocking Na⁺-Ca⁺⁺ exchanger
    c. having no effect on Na⁺-K⁺ pump
    d. increasing passive diffusion

Statement for Linked Answer Questions 27 and 28:
Nearly 46% of 45s pre-rRNA is unstable. The remaining portion of it forms mature 5.8s, 18s and 28s rRNA having lengths 160 bases, 1.9 kb and 5.1 kb respectively. The content of pre rRNA per human genome is 7.8×10^{-15} g.

27. The mol.wt. of 45s pre-rRNA is
    a. 2×10^{6}
    b. 4.5×10^{5}
    c. 4.5×10^{6}
    d. 3.9×10^{7}

28. The number of pre-rRNA genes per genome is approximately
    a. 10
    b. 100
    c. 1000
    d. 10,000

L: BIOTECHNOLOGY

ONE MARKS QUESTIONS (1-8)

1. Diauxic pattern of biomass growth is associated with
   (P) multiple lag phases
   (Q) sequential utilization of multiple substrates
   (R) simultaneous utilization of multiple substrates
   (S) absence of lag phase
   a. P,R
   b. P,Q
   c. R,S
   d. Q,S

2. Zinc fingers are characteristics of
   a. blood clotting proteins
   b. RNA chaperones
   c. DNA binding proteins
   d. lysosomal hydrolases

3. Parthenogenetic embryos in plants are those which are formed by
   a. unfertilized eggs
   b. fertilized eggs
   c. sporophytic cells
   d. male gametophyte

4. Which one of the following is the growth factor used for growth of tissues and organs in plant tissue culture ?
   a. Cysteine
   b. Cytokinin
   c. Cytidylate
   d. Cyclic AMP

5. Which of the following techniques is best suited for immobilizing an affinity ligand?
   a. Physical adsorption
   b. Gel entrapment
   c. Crosslinking with a polymer
   d. Covalent linkage to a spacer arm

6. Multiplication of genetically identical copies of a cultivar by asexual reproduction is known as
   a. aclonal propagation
   b. vegetative propagation
   c. polyclonal propagation
   d. clonal propagation

TWO MARKS QUESTIONS (7-24)

7. Identify the correct statements for the 'HAT medium'
   (P) Includes drug aminopterin to block major pathway for synthesis of deoxyribonucleotides
   (Q) Hypoxanthine is precursor for thymidine
   (R) Includes drug aminopterin to block major pathway for synthesis of polypeptides
   (S) Cells can grow in presence of aminopterin only if they have enzymes thymidine kinase and hypoxanthine-guanine phosphoribosyl transferase
   a. P, Q
   b. P, S
   c. R, S
   d. Q, S

8. A DNA fragment of 4500 bp has to be tailed with dT residues by using dTTP and the enzyme 'terminal transferase' The stock solution of dTTP that is used as a substrate has a concentration of 150 μM. Ten μl of this stock solution is added to a total volume of 200 μl reaction. What will be the concentration of dTTP in the reaction?
   a. 7.5 μM
   b. 75 μM
   c. 0.75 μM
   d. 0.075 μM

9. Determine the correctness or otherwise of following Assertion [a] and Reason [r]
   Assertion: The enzymatic degradation of cell wall to obtain single cell called protoplast has helped immensely in developing somatic cell genetics in plants

Reason: In plants or animals, fusion of two cells must occur through the plasma membrane
   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

10. In bioinformatics, the term 'BLAST' refers to
    a. database retrieval tool
    b. computational tool for sequence homology searching and alignment
    c. computational tool to view genomic sequences
    d. computational tool to view protein structures

11. Match the terms in group 1 with their possible explanations in group 2
    Group 1
    P. Orthologs
    Q. Paralogs
    R. Proteome
    S. Transgenic
    Group 2
    1. A cell or an organism having foreign gene
    2. The complement of a protein expressed by a genome
    3. Genes from different species related to each other
    4. Genes from same species related to each other
    a. P-2, Q-4, R-1, S-3
    b. P-4, Q-3, R-2, S-1
    c. P-3, Q-4, R-2. S-1
    d. P-1, Q-2, R-3, S-4

12. Which of the following statements are true with respect to a special complex called 'dicer'?
    (P) It consists of deoxyribonuclease and DNA fragments
    (Q) it consists of ribonuclease and RNA fragments
    (R) It is involved in gene silencing
    (S) It triggers apoptosis
    a. P, R
    b. Q, R
    c. P, S

d. Q, S

13. Some living cells (e.g. plant cell) have the capacity to give rise to whole organism. The term used to describe this property is
a. morphogenesis
b. androgenesis
c. totipotency
d. organogenesis

14. Match the items in group 1 with the terms given in group 2

Group 1
(P) Lactobacillos and Bifidabacteria
(Q) Polychlorobenzenes (PCBs)
(R) Fructo-oligosaccharides
(S) β-Lactams

Group 2
1. Prebiotics
2. Probiotics
3. Antibiotics
4. Xenobiotics

a. P-2, Q-4, R-1, S-3
b. P-3, Q-4, R-1, S-2
c. P-4, Q-1, R-2, S-3
d. P-1, Q-3, R-4, 5-2

15. Match the coefficients in group 1 with their corresponding downstream processing Steps given in group 2

Group 1
(P) Sedimentation coefficient
(Q) Partition coefficient
(R) Rejection coefficient
(S) Activity coefficient

Group 2
1. Aqueous two-phase extraction
2. Ultrafiltration
3. Dialysis
4. Centrifugation

a. P-3, Q-1, R-4, S-2
b. P-2, Q-1, R-4, S-3
c. P-4, Q-3, R-1, S-2
d. P-4, Q-1, R-2, S-3

16. Match the bioreactor components in group 1 with the most appropriate function given in group 2

Group 1
(P) Marine type impeller
(Q) Draft tube
(R) Diaphragm valve

(S) Sparger

Group 2
1. Recirculation of medium
2. Aeration of medium
3. Animal cell cultivation
4. Sterile operation

a. P-4, Q-2, R-1, S-3
b. P-3, Q-1, R-4, S-2
c. P-3, Q-4, R-2, S-1
d. P-2, Q-1, R-4, S-3

17. Evaluate the Michaelis constant for the following lipase catalyzed trans-esterification reaction for the production of biodiesel

$$\text{Vegetable oil + Lipase} \underset{k_1}{\overset{k_1}{\rightleftharpoons}} \text{Oil-lipase complex} \overset{k_2}{\rightarrow} \text{Biodiesel + Glycerol}$$

where, $k_1 = 3 \times 10^6 \, M^{-1} s^{-1}$; $k_1 = 4 \times 10^5 \, s^{-1}$ and $k_2 = 2 \times 10^3 \, s^{-1}$.

a. 4.2×10^{-7} M
b. 14.0×10^{-4} M
c. 6.4×10^{-6} M
d. 1.4×10^{-4} M

18. In a chemostat, evaluate the dilution rate at the cell wash-out condition by applying Monod's model with the given set of data: $\mu_{max} = 1 \, h^{-1}$; $Y_{x/s} = 0.5 \, g \, g^{-1}$; $K_s = 0.2$, g L^{-1}; $S_0 = 10 \, g \, L^{-1}$

a. $1.00 \, h^{-1}$
b. $0.49 \, h^{-1}$
c. $0.98 \, h^{-1}$
d. $1.02 \, h^{-1}$

19. Match the products in group 1 with their producer organisms given in group 2

Group 1
(P) Ethanol
(Q) L-Lysine
(R) Biopesticide
(S) Vancomycin

Group 2
1. Streptomyces orientalis
2. Saccharomyces cerevisiae
3. Coiynebacterium glutarnicum
4. Bacillus thuringiensis

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

20. A polymerase chain reaction was performed beginning with 400 template

DNA molecules in a 100 µl reaction. After 20 cycles of polymerase chain reaction, how many molecules of the amplified product will be present in 0.1 µl of reaction?

a. 2.19×10^4
b. 4.19×10^4
c. 2.19×10^5
d. 4.19×10^5

21. A bacterial culture with an approximate biomass composition of $CH_{1.8}O_{0.5}N_{0.2}$ is grown aerobically on a defined medium containing glucose as the sole carbon source and ammonia being the nitrogen source. In this fermentation, biomass is formed with a yield coefficient of 0.35 gram dry cell weight per gram of glucose and acetate is produced with a yield coefficient of 0.1 gram acetate per gram of glucose. The respiratory coefficient for the above culture will be

a. 0.90
b. 0.95
c. 1.00
d. 1.05

22. A bacterial culture having a specific oxygen uptake rate of 5 mmol O_2 (g-DCW)$^{-1}$hr^{-1} is being grown aerobically in a fed-batch bioreactor. The maximum value of the volumetric oxygen transfer coefficient is $0.18s^{-1}$ for the stirred tank bioreactor and the critical dissolved oxygen concentration is 20% of the saturation concentration (8 mg/ml). The maximum density to which the cells can be grown in the fed-batch process without the growth being limited by oxygen transfer, is approximately

a. 14 g/l
b. 26 g/l
c. 32 g/l
d. 65 g/l

Common Data Questions
Common Data for Questions 23 and 24:
An enzyme (24000 Da) undergoes first-order deactivation kinetics while catalyzing a reaction according to Michaelis-Menten kinetics ($K_m = 10^{-4}$ M). The enzyme has a turnover number of 10^4 molecules substrate/min-(molecule enzyme) and a deactivation constant (k_d) of 0.1 min at the

reaction conditions. The reaction mixture initially contains 0.6 mg/l of active enzyme and 0.02 M of the substrate.

23. The time required to convert 10% of the substrate will be approximately
a. 16 min
b. 24 min
c. 32 min
d. 8 min

24. The maximum possible conversion for the enzymatic reaction will be
a. 100%
b. 50%
c. 25%
d. 12.5%

Linked Answer Questions: Q.25 to Q.28 carry two marks each, Statement for Linked Answer Questions 25 and 26:
A Nick Translation reaction in a final volume of 100 µl was carried out by using 25 µCi of labeled $[\alpha^{-32}P]$ dCTP for labeling a 1.2 Kb γ-Interferon DNA fragment.

25. After completion of Nick translation reaction, 10 µl of reaction was spotted on a glass-fibre filter that upon counting resulted into 4.2×10^4 cpm in reaction. Another 10 µl was processed for TCA precipitation to determine radioisotope incorporation. The TCA precipitated sample gave 2.94×10^4 cpm. What is the percent of $[\alpha^{-32}P]$ dCTP incorporation into the DNA sample ?
a. 40%
b. 50%
c. 60%
d. 70%

26. if 2.94×10^4 cpm of TCA precipitable counts of the 10 µl sample were taken from 1/10 dilution of the 100 µl Nick Translation reaction containing 1 µl of γ-y-Interferon DNA, what is the specific activity of the labeled product?
a. 1.47×10^6 cpm/µg
b. 1.47×10^7 cpm/µg
c. 2.94×10^6 cpm/µg
d. 2.94×10^7 cpm/µg

Statement for Linked Answer Questions 27 and 28:

A double reciprocal plot was created from the specific growth rate and limiting-substrate concentration data obtained from a chemostat experiment. A linear regression gave values of 1.25 hr and 100 mg-hr-l^{-1} for the intercept and slope, respectively.

27. The respective values of the Monod kinetic constants μ_m (hr^{-1}) and K_s (mg/l) are as follows:
    a. 0.08, 8
    b. 0.8, 0.8
    c. 0.8, 80
    d. 8, 8

28. The same culture (with the μ_m and K_s values as computed above) is cultivated in a 10-litre chemostat being operated with a 50 ml/mm sterile feed containing 50 g/l of substrate. Assuming an overall yield coefficient of 0.3 g-DCW/g-substrate, the respective values of the outlet biomass and substrate concentration are
    a. 15 g/l, 48 mg/l
    b. 15 g/l, 0.48 g/l
    c. 48 g/l, 15 g//
    d. 4.8 g/l, 4.8 g/l

M: BOTANY

ONE MARKS QUESTIONS (1-6)

1. C_4 photosynthesis is a biochemical and structural syndrome that enhances
    a. Concentration of CO_2 in the bundle sheath cells
    b. Photorespiration
    c. Requirement of water and nitrogen
    d. Lower radiation use efficiency

2. Pioneering work conducted in green revolution
    a. C. Subramanium
    b. M. S. Swaminathan
    c. E. C. Cocking
    d. Norman Bourlag

3. 'Bordeaux mixture' contains
    a. Copper nitrate and ferric chloride
    b. Copper sulphate and slaked lime
    c. Copper sulphate and ferric chloride
    d. Ferric chloride and slaked lime

4. The 'Kornberg's enzyme' is now known as
    a. DNA polymerase III
    b. DNA polymerase II
    c. DNA polymerase I
    d. DNA ligase

5. Genome sequencing of rice will help to
    a. Characterize genes present in the rice genome
    b. Validate the genes available in other plants
    c. Control agri-business
    d. Control rice germplasm

6. Identify the correct statement
    a. Cytokinin does not regulate cell division in plants
    b. Kinetin was discovered as a breakdown product of DNA
    c. Osmotic adjustment of cells does not help water balance in plants
    d. Cytokinin enhances leaf senescence

TWO MARKS QUESTIONS (7-27)

7. Identify the correct statements
    P   Catyopsis, one-seeded thy indehiscent fruit of Gramineae
    Q   Lithocyst, a cell containing starch
    R   Aleurone layer contains protein granules and enzymes
    S   Embryo development is not of a single cell origin
    a. Q, R
    b. P, S
    c. P, R
    d. Q, S

8. NADH $\rightarrow$ Q $\rightarrow$? $\rightarrow$ Cyte$_1$ $\rightarrow$? $\rightarrow$ Cyt (a + a$_3$) $\rightarrow$ O$_2$
   Sequence of electron transfer in oxidative phosphorylation is given above. Complete the missing sequence
    a. Cyta and Cytb
    b. Cyta and Cytc
    c. Cytb and Cytc
    d. Cyth and Cytb$_1$

9. Which of the following statements are true on phytoremediation point of view?

P An effective technology that uses plants to tolerate and accumulate metals from the environment

Q Detoxification of soil phenolic pollutants by plant secretory enzymes

R Using RT-PCR to quantify gene expression in plants

S Studies on plant phylogeny and exploiting the biodiversity

a. P, Q
b. P, R
c. R, S
d. P, S

10. Identify the correct statements

P The second law of thermodynamics is also known as the law of conservation of energy

Q Bntropy' is a measure of the available energy resulting from transformations

R The transfer of energy through the food chain of an ecosystem is termed as 'energy flow'

S The second law of themodynamics deals with the transfer of energy towards more available state

a. P, Q
b. P, R
c. Q, R
d. Q, S

11. Red flower (R) dominant to white flower (r) and short pollen grain (1) recessive to long pollen grain (L) are two genes on chromosome no. 2 of sweet pea. Plants with red flower and long pollen grains were crossed with plants with white flower and short pollen grains. The hybrids were test crossed and the following progenies were obtained in the F_2

a. : Red flower with long pollen grain
ss. : Red flower with short pollen grain
35 : White flower with long pollen grain
350 : White flower with short pollen grain

What would be the map distance between R and L ?

a. 16cM
b. 8cM
c. 10cM

d. 30cM

12. Oryza sativa and Michelia champaca belong to the following families

P Gramineae and Chenopodiaceae
Q Brassicaceae and Malvaceae
R Gramineae and Magnoliaceae
S Cyperaceae and Myristicaceae

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

13. Identify the correct statements

P Agar is manufactured from Gelidium of Rhodophyceae and algenic acid from Laminaria of Pheophyceae

Q All mushrooms are edible and coloured mushrooms are poisonous

R Dioscorea sp. produce diosgenin used as antifertility drugs

S Gossypium produce high qualityjute fibre

a. P, R
b. P, Q
c. Q, R
d. R, S

14. Identify the correct statements

P Heterosis is a proven way of increasing productivity of many crop plants

Q Weed caused considerable yield loss and reduce fanner's income

R PR (Pathogenesis related) proteins protect plants against bacteria

S Marker assisted selection can improve crops in field

a. P, S
b. R, S
c. Q, R
d. P, Q

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

P Biodiversity is affected by environmental pollution

Q Alternative agriculture is designed to sustain crop yield while enhancing inputs of fossil fuel, pesticides, etc.

R Global climate change is caused by human activities

S Acid rain is caused by excessive CO_2 in the air

a. P, Q
b. P, R
c. Q, R
d. R, S

Q. 16 - Q. 22 are matching exercises. In each question, each item P, Q, R and S in Group I matches one of the items in Group II. Choose the correct match from the alternatives A, B, C and D.

16. Group I

S $Fe^{3+} + K_4[Fe(CN)_6] \rightarrow Fe_4[Fe(CN)_6]_3 + 4K^+$
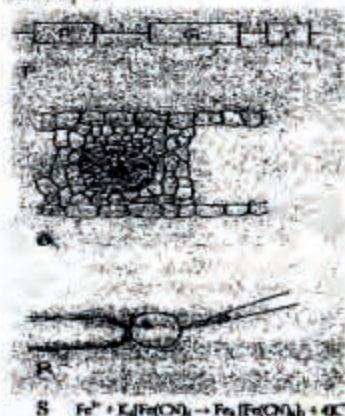
Group II

1. Kranz anatomy
2. Single protoplast culture
3. Binary vector
4. Microinjection
5. Partial plasmid map
6. Ferric-Ferro-Cyanide complex

	(A)	(B)	(C)	(D)
a.	P-3	P-s	P-5	P-3
b.	Q-l	Q-l	Q-l	Q-4
c.	R-4	R-2	R-4	R-1
d.	S-6	S-3	S-6	S-6

17. Group-I
P Foliaceous bracts
Q Spathe
R Petaloid bracts
S Involucre
Group- II
1. A large and commonly boat shaped bract enclosing a cluster of flowers
2. One or more whorls of bracteoles developing at the base of a calyx
3. Green, flat and leaf like in appearance
4. Brightly coloured bracts looking somewhat like petals
5. Special bracts- small, dry and scaly
6. One or more whorls of bracts, normally green in colour present around a cluster of flowers

	(A)	(B)	(C)	(D)
a.	P-5	P-3	P-3	P-4
b.	Q-2	Q-1	Q-6	Q-5
c.	R-3	R-4	R-3	R-2
d.	S-4	S-6	S-2	S-1

18. Group-I
P Atropin
Q Cocaine
R Digitalis
S Hops
Group- II
1. Digitalis purpurea
2. Triticum aestivum
3. Erythroxylon coca
4. Humulus lupulus
5. Atropa belladonna
6. Datura stramonium

	(A)	(B)	(C)	(D)
a.	P -6	P-3	P-5	P-6
b.	Q-5	Q-2	Q-3	Q-5
c.	R-4	R-4	R-1	R-3
d.	S-2	S-1	S-4	S-1

19. Group-I
P Late blight of potato
Q Early blight of potato
R Black scurf of potato
S Wart diseases of potato
Group- II
1. Synchytrium endobioticum
2. Rhizoatonia solani
3. Alternaria solani
4. Phytophthora colocasiae
5. Phytophthora arecaceae
6. Phytophthora infestans

	(A)	(B)	(C)	(D)
a.	P-6	P-6	P-5	P-4
b.	Q-3	Q-3	Q-3	Q-3
c.	R-2	R-1	R-2	R-2
d.	S-1	S-2	S-1	S-1

20. Group-I
P Insect Resistance Rice
Q Non-antibiotic selection system
R Antibiotic marker gene
S C_4 photosynthesis

Group- II

1. psy
2. crylAb
3. hpt
4. PEPC
5. PMI
6. Rubisco

	(A)	(C)	(D)	(B)
a.	P-2	P-5	P-2	P-1
b.	Q-1	Q-2	Q-5	Q-2
c.	R-3	R-1	R-3	R-4
d.	S-4	S-6	S-4	S-6

21. Group-I

P P. Maheshwari
Q E. Hood
R B. McClintock
S S. M. Sarkar

Group- II

1. Plant embryology
2. Genetics
3. Agrobacterium transformation
4. Growth hormone
5. Molecular biology
6. Systematic botany

	(A)	(B)	(C)	(D)
a.	P-1	P-1	P-1	P-2
b.	Q-6	Q-3	Q-2	Q-1
c.	R-3	R-2	R-6	R-5
d.	S-2	S-4	S-5	S-3

22. Group-I

P IPR
Q Selectable reporter gene
R Vectorless DNA transfer
S Selectable marker gene

Group- II

1. Intellectual property rights
2. International plant registration
3. Protoplast system
4. Agrobacterium system
5. Neomycin phosphotranferase
6. Green fluorescent protein

	(A)	(B)	(C)	(D)
a.	P-1	P-1	P-2	P-2
b.	Q-6	Q-6	Q-6	Q-5
c.	R-3	R-4	R-3	R-4
d.	S-5	S-2	S-5	S-6

Common Data Questions

Common Data for Questions 23 and 24:

Union of stamens may involve adhesion or cohesion. Arrangement of stamens of a flower is given below:

23. Identify the type of stamen
   a. Diadelphous
   b. Monadelphous
   c. Polydelphous
   d. Syngenesious

24. Identify the family from the type of stamens
   a. Malvaceae
   b. Solanaceae
   c. Compositae
   d. Apiaceae

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

Statement for Linked Answer Questions 25 and 26:

The following reaction is taking place in aerobic organisms
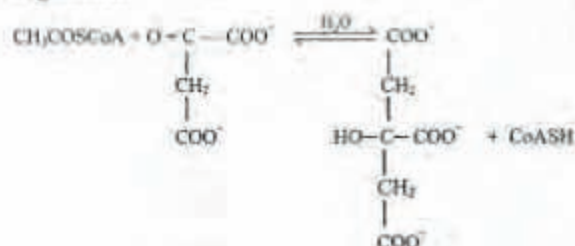
25. Identify the products from the above reaction
   a. Isocitrate and Coenzyme A
   b. Citrate and Coenzyme A
   c. Pyruvate and acetyl CoA
   d. Succinate and acetyl CoA

26. Identify the enzyme and the type of reaction

a. Citrate synthase and condensation reaction
b. Citrate synthatase and condensation reaction
c. Isocitrate dehydrogenase and oxidative decarboxylation
d. Aconitase and dehydration reaction

Statement for Linked Answer Questions 27 and 28:

The visible spectrum of light lies between 400-700 nm. The correlation of expression of wavelength is given below:

$1m \rightarrow 10^3 mm \rightarrow 10^6 \mu m \rightarrow 10^9 nm \rightarrow 10^{10} A^\circ$

	Colour Spectrum	Wavelength (nm)
P	Blue	1. 500-550
Q	Green	2. 450-500
R	Yellow	3. 650-700
S	Red	4. 550-600

27. Identify the correct combination from the above options

	(A)	(B)	(C)	(D)
a.	P-1	P-2	P-2	P-3
b.	Q-2	Q-1	Q-1	Q-1
c.	R-4	R-3	R-4	R-2
d.	S-3	S-4	S-3	S-4

28. For conversion of wavelength from nm to A° and µm
a. Divide the wavelength by 10 and 10^{-3}
b. Multiply the wavelength by 10 and 10^{-3}
c. Divide the wavelength by 10 and 10^{-4}
d. Multiply the wavelength by 10 and 10^{-3}

N: MICROBIOLOGY

ONE MARKS QUESTIONS (1-6)

1. Which is the most modern method of classification of organisms?
a. Morphology
b. Gram staining
c. Biochemical characterization
d. 16S rRNA sequence

2. The mode of action of sulfonamides is by inhibition of
a. Cell wall synthesis
b. Folic acid metabolism
c. DNA replication
d. Sulphur metabolism

3. The Ziehl-Neelsen staining technique is used for the detection of
a. Endospores
b. Capsule
c. Flagella
d. Cell wall

4. A solution of ampicillin is
a. Sterilized by autoclaving
b. Sterilized by dry heat
c. Sterilized by membrane filtration
d. Need not be sterilized

5. Fixation of molecular nitrogen is carried out by
a. A multi-enzyme complex containing nitrogenase and nitrogenase reductase
b. Nitrogenase
c. Nitrogenase reductase
d. Nitrate reductase

6. The complement fixation test for syphilis was introduced by
a. Theobald Smith
b. Walter Reed
c. Martinus Willem Beijerinck
d. August von Wassermann

TWO MARKS QUESTIONS (7-24)

7. You have a culture of metabolically inactive E. coil. To make protoplasts you will use
a. Penicillin
b. Lysozyme
c. Hypertonic solution + penicillin
d. Hypertonic solution + lysozyme

8. The Ames test is carried out on 3 strains of Salmonella typhimurium having 3 different kinds of mutations in the his gene. Two mutagens, acridine orange and ethyl methane sulfonate (EMS), are used in this experiment and the following results are obtained.

Strain	Number of revertants/10⁷ cells		
	Acriflavine orange	EMS	No mutagen
P	1000	1	1
Q	2	101	1
R	2	3	1

Based on the chemical nature of the mutagens, the nature of the mutation in the his gene in the 3 strains is

a. P- silent Q- insertion R- base substitution

b. P- insertion Q- silent R- frameshift

c. P- frameshift Q- base substitution R- insertion

d. P- base substitution Q- frameshift R- silent

9. You isolate a natural plasmid from a tetracycline resistant strain of E.coli. You heat denature the plasmid, allow it to self anneal and observe the DNA by electron microscopy. The predominant DNA structure observed is shown schematically below.

The plasmid is most likely to contain a

a. Phage DNA

b. Transposon

c. Transfer operon

d. T DNA

10. For which of the following diseases does the causative agent NOF strictly obey Koch's postulates?

a. Tuberculosis

b. Cholera

c. Bovine spongiform encephalopathy

d. Bird flu

11. An E. coli culture is mutagenized to obtain leucine auxotrophs. The auxotroph can be identified by plating on medium

a. Containing leucine

b. Lacking leucine

c. Containing leucine followed by replica plating onto (B)

d. Lacking leucine followed by replica plating onto (A)

12. An agent used in the cosmetic treatment of facial wrinkles is isolated from

a. Shigella sp.

b. Bacillus anthracis

c. Clostridium botulium

d. Aspergillus flavus

13. Three restriction endonucleases P, Q and R recognize 4bp, 6bp and 8bp sequences respectively. The relative frequency of occurrence of these sequences on a bacterial genome is

a. P>Q>R

b. P>R>Q

c. R>Q>P

d. Q>R>P

14. The alternate pathway of complement-mediated cell lysis is triggered by

a. Bacterial polysaccharide

b. Bacterial polysaccharide + antibody to the polysaccharide

c. Antibody to the polysaccharide

d. All of the above

15. Anaphylaxis is initiated by

a. IgE bound to mast cells

b. Antigen bound to IgB on mast cells

c. Antigen bound to mast cells

d. All of the above

16. For which one of the following operations are dilution rate and limiting a specific nutrient the important parameters?

a. Batch fermentation

b. Fed batch fermentation

c. Chemostat

d. Turbidostat

17. By doubling the concentration of an enzyme the

a. K_m will remain constant and V_{max} will increase

b. K_m and V_{max} will increase

c. K_m and V_{max} will decrease

d. K_m will increase and V_{max} will remain constant

18. Glycosidic linkages between D-glucose residues in starch and cellulose respectively are

a. $(\alpha 1 \rightarrow 4)$ and $(\beta 1 \rightarrow 4)$

b. $(\alpha 1 \rightarrow 4)$ and $(\alpha 1 \rightarrow 4)$

c. $(\beta 1 \rightarrow 4)$ and $(\beta 1 \rightarrow 4)$

d. $(\beta 1 \rightarrow 4)$ and $(\alpha 1 \rightarrow 4)$

19. The enzymes responsible for generation of ATP in E. colt by substrate level phosphorylation and the electron transport system are located respectively in the

a. Cytoplasm and plasma membrane

b. Plasma membrane and cytoplasm

c. Cytoplasm and outer membrane

d. Outer membrane and cytoplasm

20. Which reducing agent is NOT naturally present in the cell?

a. Ascorbic acid

b. Glutathione

c. Cysteine

d. Dithiothreitol

21. The TCA cycle begins by the condensation of the two carbon compound (P) with the four carbon compound (Q) to form the six carbon compound (R). Here P, Q, R represent

a. Oxaloacetate, Citrate, Acetyl~CoA

b. Acetyl~CoA, Oxaloacetate, Citrate

c. Citrate, Oxaloacetate, Acetyl~CoA

d. Acetyl~CoA, Citrate, Oxaloacetate

22. In glycolysis the conversion of glucose to two pyruvate molecules gives a net yield of

a. 2 ATP

b. 4 ATP +2 NADH

c. 2 ATP +2 NADPH

d. 2 ATP + 2 NADH

Common Data Questions

Common Data for Questions 23 and 24:

A

(P) Retroviridae

(Q) Herpesviridae

(R) Rhabdoviridae

(S) Baculoviridae

B

(1) Linear double stranded DNA

(2) Minus strand RNA

(3) Circular double stranded DNA

(4) Plus strand RNA

23. Match the columns.

a. P-1, Q-2, R-3, S-4

b. P-2, Q-3, R-4, S-1

c. P-3, Q-4, R-1, S-2

d. P-4, Q-1, R-2, S-3

24. Which one of the GENOMES listed above is NOT infectious when introduced into host cells by liposomes?

a. Linear double stranded DNA

b. Minus strand RNA

c. Circular double stranded DNA

d. Plus strand RNA

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

Statement for Linked Answer Questions 25 and 26:

A gene is negatively regulated by a repressor that binds to an operator with a dissociation constant (K_D) of 10^{-9} M. There are 100 molecules of repressor per cell and the cell volume is 10^{-8} ml.

25. Assuming the Avogadro number (N) to be 10^{23} molecules, what is the concentration of the repressor in the cell?

a. 10^{-8} M

b. 10^{-9} M

c. 10^{-10} M

d. 10^{-11} MM

26. At this concentration of the repressor, the gene is

a. Repressed

b. Transiently repressed

c. Partially expressed

d. Expressed

Statement for Linked Answer Questions 27 and 28:

A suspension of temperate phage contains 10^7 particles/ml. Only 10% of these are capable of infecting bacteria. Hundred microlitres of the phage suspension is mixed with 1000 bacterial cells.

27. What is the multiplicity of infection (MOI)?

a. 10^3

b. 10^2

c. 10^1

d. 10^0

28. At this MOI

a. Lysogeny is favoured

b. Lytic cycle is favoured

c. Both lysogeny and lytic cycle are equally favoured

d. The bacterial cells do not get infected

O: ZOOLOGY

ONE MARKS QUESTIONS (1-6)

1. In theories of evolution, the example that a giraffe stretching the neck to reach on higher branches has been used to explain the following:
   a. Use and disuse theory
   b. The concept of inheritance of acquired characters
   c. Intelligent design
   d. Both A and B

2. Which of the following statements is true for the systematics of the animal kingdom?
   a. Systematics employs a hierarchical system of classification
   b. Systematics can also be based on cladistic analysis
   c. Systematics can infer phylogeny from molecular data
   d. All the above

3. Most modern taxonomists group living organisms into how many kingdoms?
   a. 2
   b. 3
   c. 4
   d. 5

4. In many terrestrial vertebrates, including humans, the sensory organ for hearing and equilibrium are closely associated within the inner ear. Which of the following parts in the inner ear represents the organ of equilibrium?
   a. Tectorial membrane
   b. Tymphanic membrane
   c. Semicircular canals
   d. Sacule

5. Which combination of mechanisms best explain cross-continental migration of animals ?
   a. Orientation and navigation
   b. Orientation and piloting
   c. Navigation and piloting
   d. Orientation, navigations, and piloting

6. Hemolin is
   a. An antibody produced by sponges
   b. An antibody produced by annelids
   c. A member of the immunoglobulin super family
   d. A cytotoxic molecule produced by nepiatodes

TWO MARKS QUESTIONS (7-24)

7. The fossil records suggest evolutionary trends. Choose the correct statement:
   a. An evolutionary trend does NOT imply that evolution is goal oriented
   b. An evolutionary trend implies that evolution is goal oriented
   c. Fossil record can NOT be considered as indicators of evolutionary process
   d. A fossilized specimen undergoes gradual change over time that "mimics" the evolutionary process

8. Which of the following statements identify the term "biological magnification"?
   a. Green house effect will have greater impact on tropical countries
   b. Toxins become concentrated in successive trophic levels of food webs
   c. Energy is lost at each level in a food chain
   d. Primary producers are at the bottom of the food chain

9. Honey bee returning to the hive from a food source performs a "waggle dance". It indicates the:
   a. Distance between the beehive and the food source
   b. Direction to the food resource
   c. The type of food available in the source
   d. All of the above

10. Choose the choice that correctly pairs the following:
    A. initial response to antigen
    B. Cytokines
    C. Passive immunity to foetus
    D. Humoral immunity
    E. Phagocytosis
    1. Coelomocytes
    2. IgM
    3. IgG
    4. T cells
    5. B cells
    a. A-4; B-3; C-2; D-5; E-1
    b. A-1; B-4; C-5; D-3; E-2

c. A-2; B-4; C-3; D-5; E-1

d. A-2; B-4; C-1; D-4; E-3

11. Which of the following is correctly paired?

a. Blastopore -organizer

b. Regulative development -syncytial specification

c. Vegetal pole – mesoderm

d. Spiral cleavage -chick embryo

12. Which of the following is seen in an adult frog?

a. Somite

b. Notochord

c. Branchial arches

d. None of the above

13. Which of the following has all the pairs correct?

A. Ectoderm

B. Mesoderm

C. Endoderm

D. Ectoderm

E. Mesoderm

1. Heart

2. Stomach

3. Enteric neuron

4. Skull

5. Kidney

a. A-3; B-2; C-1; D-4; E-5

b. A-3; B-1; C-2; D-4; E-5

c. A-2; B-4; C-5; D-1; E-3

d. A-2; B-1; C-5; D-3; E-4

14. Which combination of following statements is true?

1. Hox genes have undergone multiple duplications during animal evolution.

2. For some reptiles, sex is determined by environmental factor(s).

3. Metamorphosis in amphibians is regulated by nuclear hormone receptor signaling.

a. 1 and 2

b. 1 and 3

c. 2 and 3

d. 1, 2 and 3

15. The 5-untranslated region (5'-UTR) is found:

a. Upstream of the promoter

b. Within the first intron

c. Within the first exon

d. Immediately upstream of the splice acceptor site

16. A:T and G:C ratios in a newly discovered organism are 0.63 and 0.8, respectively. Genome of this organism is likely to have:

a. Single stranded DNA

b. Double stranded DNA

c. Single stranded RNA

d. Double stranded RNA

17. During enzyme-catalyzed reaction, a competitive inhibitor acts by:

a. Reducing activation energy

b. Increasing activation energy

c. Reducing effective substrate concentration

d. Increasing effective substrate concentration

18. Which of the following pairs is NOT correct?

a. Reverse transcriptase - DNA synthesis

b. Primase - RNA synthesis

c. Acetyl transferase - Transcription

d. Reverse transcriptase - transcription

19. In an organism with diploid chromosome number of 8, the cells at anaphase II will display:

a. 4 chromosomes

b. 2 chromosomes with 4 chromatids

c. 4 chromatids

d. 8 sister chromatids

20. Symbiotic microbes that help the digestive process in ruminants live in a specialized part of the alimentary canal known as:

a. Liver

b. Pharynx

c. Stomach

d. Cecum

21. In animals, respiration and circulatory systems are often functionally interlinked. Which animal group represents an exception?

a. Aquatic mammals

b. Fish

c. Terrestrial insects

d. Amphibians

22. Match the term with the correct description:

A. Gene flow

B. Natural selection

C. Mutations

D. genetic drift

1. Source of new alleles

2. Changes in a population's allele frequencies due to chance alone

3. Allele frequencies changes due immigration, emigration, or both

4. Outcome of differences in survival and reproduction among individuals that vary in forms shared traits

a. A-3, B-4, C-1, D-2

b. A-4, B-3, C-2, D-1

c. A-2, B-1, C-4, D-3

d. A-2, B-4, C-3, D-1

Common Data Questions

Common Data for Questions 23 and 24:

Many nematodes are parasites on animals. Ascaris lumbricoides is an example of nematode parasite on human. It infects more than 1 billion people in Africa and Asia. Ascaris passes through several stages of its life cycle inside the human body.

23. Ascaris lumbricoides enters the human host in which stage of its life cycle?

a. Egg

b. Larva

c. Adult

d. Adult female

24. During its life cycle within the host, Ascaris migrates from

a. Intestine to heart

b. Intestine to brain

c. Lungs to throat

d. Intestine to liver

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

Statement for Linked Answer Questions 25 and 26:

Synthetic progesterone and estrogen are commonly used as birth control pills. Based on your understanding of hormonal regulation of reproduction, answer the following 2 questions.

25. These two hormones act by

a. Negative feedback to stop the release of GnRH

b. Positive feedback by increasing the release of LH and FSH hormones

c. Increasing the level of LH and decreasing the level of FSH

d. Decreasing the level of LH and increasing the level of FSH

26. During a menstrual cycle in human female, elevated levels of progesterone indicates that the process of ovulation is:

a. Yet to occur

b. Completed

c. Advanced

d. Delayed

Statement for Linked Answer Questions 27 and 28:

When an animal of the genotype AaBb was mated with another of the genotype aabb (test cross), the following progeny were observed:

AaBb —980; aabb —976; Aabb —287 and aaBb —291

27. Based on your understanding of the law of independent assortment, what ratios of progeny phenotypes are expected in a test cross (AaBb x aabb)?

a. 1:1:1:1

b. 2:2:1:1

c. 1:2:1:2

d. 1:1:2:2

28. Based on your answer to the previous question, which one of the following statements MOST accurately describes the test cross results mentioned above?

a. Genes A and B are on different chromosomes

b. Genes A and B are probably on the same chromosome

c. Inheritance of A is modified by B

d. Genes A and B assort independently