

# LIFE SCIENCES

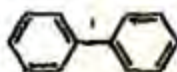
## H : CHEMISTRY (COMPULSORY)

### ONE MARKS QUESTIONS (1-10)

1. Elements exhibiting +2 oxidation state in their compounds is:
  - a. Zn and P
  - b. Ca and Al
  - c. Al and P
  - d. Zn and Ca
2. The paramagnetic species is:
  - a.  $\text{Na}_2$
  - b.  $\text{NO}^+$
  - c. CN
  - d. CO
3. Hydride that readily liberates hydrogen gas on reaction with water is:
  - a.  $\text{NaBH}_4$
  - b.  $\text{CaH}_2$
  - c.  $\text{SiH}_4$
  - d.  $\text{NH}_3$
4. Which one of the following is aromatic?
  - a.



b.



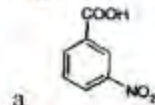
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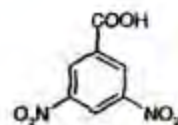
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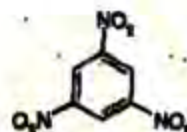
5. Identify the product of the following reaction.



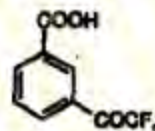
b.



c.



d.



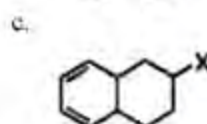
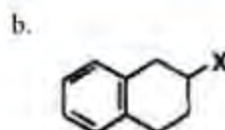
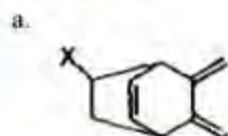
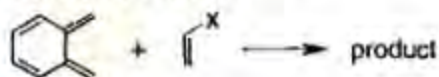
6. Which one of the following is most acidic?
  - a. Butanoic acid
  - b. 3-Chlorobutanoic acid
  - c. 2-Chlorobutanoic acid
  - d. 4-Chlorobutanoic acid
7. Total number of stereoisomers possible in  $\text{CH}_3\text{-CH(Ph)-CH=CHCH}_3$  is:
  - a. 1
  - b. 2
  - c. 3
  - d. 4
8. The standard EMF of the cell, set up from the reaction  $2\text{Cu}^+(\text{aq}) \rightarrow \text{Cu(s)} + \text{Cu}^{2+}(\text{aq})$  is 0.36 V at 298 K. The standard Gibbs free energy in kJ/mol for this reaction is:
  - a. -34.73
  - b. -69.46
  - c. -3473
  - d. -6946
9. Heisenberg's uncertainty principle is expressed as:
  - a.  $\Delta p \Delta x \geq h/2\pi$
  - b.  $\Delta p \Delta x \leq h/4\pi$
  - c.  $\Delta p \Delta x \leq h/2\pi$
  - d.  $\Delta p \Delta x \geq h/4\pi$
10. For the reaction,  $\text{C}_6\text{H}_{12}\text{O}_6(\text{s}) + 6\text{O}_2(\text{g}) \rightarrow 6\text{CO}_2(\text{g}) + 6\text{H}_2\text{O}(\text{l})$ ,  $\Delta U = -2810$  kJ/mol.  $\Delta H$  in kJ/mol is:
  - a. 845

- b. -890  
 c. -2810  
 d. -2864

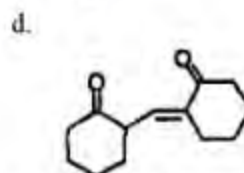
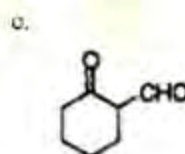
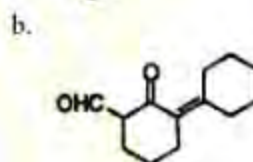
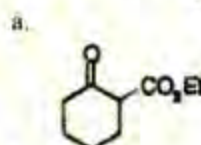
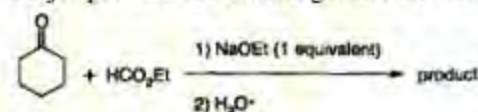
### TWO MARKS QUESTIONS (11-28)

11. Which one of the following is a repeating unit of silicone?  
 a.  $\text{Si}(\text{CH}_3)_4$   
 b.  $\text{Si}(\text{CH}_3)_2\text{O}$   
 c.  $\text{SiO}_2$   
 d.  $\text{Si}(\text{OCH}_3)_4$
12. The order of lattice energy of NaX is  $\text{NaI} < \text{NaBr} < \text{NaCl} < \text{NaF}$ . The property of  $\text{X}^-/\text{X}^+$ , responsible for the trend is:  
 a. ionic radii  
 b. electro-negativity  
 c. atomic radii  
 d. electron affinity
13. Among  $\text{BF}_3$ ,  $\text{CF}_4$ ,  $\text{PF}_3$ , and  $\text{OF}_2$ , the molecules that are expected to have a zero dipole moment is:  
 a.  $\text{OF}_2$  and  $\text{CF}_4$   
 b.  $\text{BF}_3$  and  $\text{PF}_3$   
 c.  $\text{OF}_2$  and  $\text{PF}_3$   
 d.  $\text{BF}_3$  and  $\text{CF}_4$
14. Air oxidation of sodium metal produces a hygroscopic compound 'X', which reacts with  $\text{CO}_2$  to produce 'Y'. X and Y respectively are:  
 a.  $\text{Na}_2\text{O}_2$  and  $\text{Na}_2\text{CO}_3$   
 b.  $\text{Na}_2\text{O}$  and  $\text{NaHCO}_3$   
 c.  $\text{NaOH}$  and  $\text{Na}_2\text{CO}_3$   
 d.  $\text{Na}_2\text{O}$  and  $\text{Na}_2\text{CO}_3$
15. The product of reaction of  $\text{HNO}_3$  with  $\text{P}_3$  and  $\text{P}_4\text{O}_{10}$  respectively are:  
 a.  $\text{N}_2\text{O}_3$  and  $\text{N}_2\text{O}_5$   
 b.  $\text{N}_2\text{O}_5$  and  $\text{NO}_2$   
 c.  $\text{NO}_2$  and  $\text{N}_2\text{O}_5$   
 d.  $\text{NO}$  and  $\text{NO}_2$

16. Identify the product for the following Diels-Alder reaction



17. Major product of reaction given below is:



18. 0.050 mol of Ar initially at  $25^\circ\text{C}$ , expands adiabatically and reversibly from 0.50 L to 1.00 L ( $C_{v,m}$  for Ar is  $12.48 \text{ J/Kmol}$ ). The work done in this process is:

- a. 117 J  
 b. -69 J  
 c. -138 J  
 d. -1378 J

19. Efficiency of a reversible cyclic heat engine working between  $T_c$  and  $T_h$ , is:

- a.  $-T_c/T_h$   
 b.  $(T_c - T_h)/T_h$   
 c.  $(T_h - T_c)/T_h$   
 d.  $T_c/T_h$



20. To prepare one liter of an acetate buffer of 0.1 ionic strength and pH 5, at 25 °C, the moles of sodium acetate and acetic acid (dissociation constant =  $2.69 \times 10^{-5}$ ) to be added respectively are:
- 0.1 and 0.0372
  - 0.0372 and 0.1
  - 0.01 and 0.372
  - 0.372 and 0.01
21. The EME of the cell (Pt,H<sub>2</sub>(1 atm)|HCl(aq)|AgCl, Ag) is 0.332 V and the EMP of AgCl|Ag electrode is 0.277 V. pH of the solution is:
- 0.926
  - 1.03
  - 3.26
  - 5.61
22. In a saturated aqueous solution of CaF<sub>2</sub>, the concentrations of Ca<sup>2+</sup> and F<sup>-</sup> are  $3.3 \times 10^{-4}$  M and  $6.7 \times 10^{-4}$  M, respectively. On adding NaF to this solution, if the concentration of Ca<sup>2+</sup> changes to  $1.5 \times 10^{-4}$  M, then molar concentration of F<sup>-</sup> will be:
- $1.0 \times 10^{-8}$
  - $1.0 \times 10^{-6}$
  - $1.0 \times 10^{-4}$
  - $1.0 \times 10^{-3}$
25. Hydrochloric acid produces a halogenated compound as major product. The product is:
- Me<sub>3</sub>C-CH(Cl)-CH<sub>3</sub>
  - Me<sub>3</sub>C-CH<sub>2</sub>-CH<sub>2</sub>Cl
  - Me<sub>2</sub>C(Cl)-CHMe<sub>2</sub>
  - Me<sub>2</sub>C(Cl)-CH<sub>2</sub>CH<sub>2</sub>CH<sub>3</sub>
26. Hg(OCOCH<sub>3</sub>)<sub>2</sub> followed by treatment with alkaline NaBH<sub>4</sub> produces:
- Me<sub>2</sub>C(OH)-CHMe<sub>2</sub>
  - Me<sub>2</sub>C(OH)-CH<sub>2</sub>CH<sub>2</sub>CH<sub>3</sub>
  - Me<sub>3</sub>C-CH<sub>2</sub>-CH<sub>2</sub>OH
  - Me<sub>3</sub>C-CH(OH)-CH<sub>3</sub>

**Linked Answer Questions: 25.1 to 28.3 carry two marks each.**

**Statement for Linked Answer Questions 25.a and 27.2:**

A pink colored aqueous solution of CoCl<sub>2</sub> changes immediately to blue, on adding excess of Cl<sup>-</sup> ion.

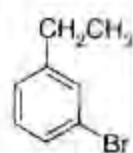
- 27.1 The blue coloured species is:
- [CoCl<sub>6</sub>]<sup>3-</sup>
  - [CoCl<sub>4</sub>]<sup>2-</sup>
  - [Co(H<sub>2</sub>O)<sub>6</sub>]<sup>2+</sup>
  - [CoCl<sub>4</sub>]<sup>1-</sup>
- 27.2 The d-electron configuration for the blue complex ion is:
- e<sup>3</sup> t<sub>2</sub><sup>3</sup>
  - t<sub>2</sub><sup>5</sup> e<sub>g</sub><sup>2</sup>
  - t<sub>2</sub><sup>4</sup> e<sub>g</sub><sup>3</sup>
  - e<sup>4</sup> t<sub>2</sub><sup>3</sup>

**Statement for Linked Answer Questions 28.1 and 28.2 :**

Ethylbenzene reacts with,

- 28.1 N-bromosuccinimide to produce a compound 'X'. X is :

(a)



(b)

### Common Data Questions

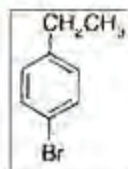
#### Common Data for Questions 23 and 24:

Reaction: A + B → products

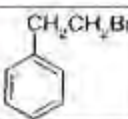
23. When the reaction is first order in A and zero order in B, rate constant is:
- $\{-1/t([A]_0)\} \ln([A]_0/[A]_t)$
  - $\{-1/t\} \ln([A]_0/[A]_t)$
  - $\{1/t([A]_0)\} \{([A]_t - [A]_0)/[A]_0[A]_t\}$
  - $\{1/t([A]_0)\} \{1/[A]_t - 1/[A]_0\}$
24. When the reaction is second order in A and zero order in B, rate constant is:
- $(1/t) \{([A]_t - [A]_0)/([A]_0[A]_t)\}$
  - $(1/t) \{1/[A]_t - 1/[A]_0\}$
  - $\{1/t([A]_0)\} \{([A]_t - [A]_0)/([A]_0[A]_t)\}$
  - $\{1/t([A]_0)\} \{1/[A]_t - 1/[A]_0\}$

#### Common data for Q.25 & Q.26:

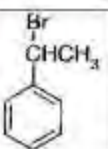
3,3-dimethyl-1-butene (Me<sub>3</sub>C-CH=CH<sub>2</sub>), on reaction with



(c)

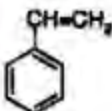


(d)

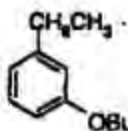


28.2 'X' on treatment with t-BuOK in butanol provides 'Y'. The product Y is:

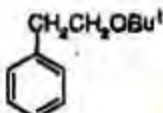
(a)



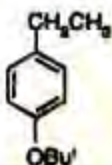
(b)



(c)



(d)



## I : BIOCHEMISTRY

### ONE MARKS QUESTIONS (1-10)

- Which pair of amino acid residues can interact in the interior of a protein only through van der Waals forces?
  - Arg, Thr
  - Ser, Thr
  - Glu, His
  - Val, Leu

- Okazaki fragments are joined by the enzyme
  - RNA polymerase
  - DNA polymerase
  - DNA ligase
  - Reverse transcriptase
- The biosynthetic reactions in a cell mainly take place in
  - Mitochondria
  - Lysosomes
  - Smooth endoplasmic reticulum
  - Golgi apparatus
- Colechicine inhibits
  - DNA replication
  - Formation of spindle fibers
  - Condensation of chromosomes
  - Cytokinesis
- The active form of Testosterone is
  - Dihydrotestosterone
  - Dehydrotestosterone
  - Dihydroxytestosterone
  - Dehydroepiandrosterone
- The sensitivity of a radioimmunoassay depends primarily on
  - Titer of the antibody
  - Specificity of the antibody
  - Specific activity of the ligand
  - Purity of the antigen
- In eukaryotes, introns can be found in transcripts which are precursors of
  - mRNA
  - rRNA
  - tRNA
  - All of the above
- Homologous recombination can be employed to generate
  - Transgenic animals
  - Gene knock-out animals
  - Site specific mutagenesis
  - Specific promoter sequences
- The mode of action of widely used anticancer drug methotrexate is to inhibit
  - Dihydrofolate reductase
  - Dihydroorotate dehydrogenase
  - Carbamoyl phosphate synthase-2
  - Ribonucleotide reductase



10. For a double stranded DNA which one of the following base-ratios will always be equal to 1?
- $(A+T)/(G+C)$
  - $(A+G)/(C+T)$
  - C/T
  - A/G

### TWO MARKS QUESTIONS (11-26)

11. Activated fatty acyl groups are transported into the mitochondria by
- Coenzyme A
  - Oxaloucetate
  - Carnitine
  - Citrate
12. A mixture of Cytochrome-C (MW 1.7 KD) and Myoglobin (MW 17.2 KD) are to be separated by polyacrylamide gel electrophoresis. Their isoelectric pH (pI) values are 9.6 and 7.2 respectively. In which direction will each protein migrate at pH 8.5?
- Myoglobin will migrate to anode and Cytochrome-C will migrate to Cathode
  - Myoglobin will migrate to anode and Cytochrome-C will migrate to anode
  - Both will migrate to anode
  - Both will migrate to cathode
13. Which one of the following fatty acids will have melting point higher than that of palmitic acid (16:0)?
- Myristic acid (14 : 0)
  - Palmitoleic acid (16:1)
  - Oleic acid (18:1)
  - Stearic acid (18:0)
14. A diabetes mellitus patient excretes glucose in Urine even when kept on carbohydrate free diet. This is because
- Fats are catabolised in liver to form glucose
  - Amino acids are catabolised in liver to Form glucose
  - Increased production of amino acids
  - Increased breakdown of glycogen
15. According to the second law of thermodynamics, molecules spontaneously move from region of higher concentration to one of lower concentration. However, sodium ions are present at 143 mM outside the cell and 14 mM inside the cell. Yet sodium cannot pass through the plasma membrane. Transport of sodium into the cell is achieved by
- Facilitated diffusion
  - Release of acetyl choline
  - Release of norepinephrine
  - Sodium transporter
16. The choice of the enzyme used in ELISA depends on
- Purity of the enzyme
  - Turnover number
  - Its absence in biological sample which is being analysed
  - Its availability in bulk
17. The T cell antigen receptor
- Recognises conformational epitopes on the native molecule
  - Has Ig light chains
  - Is made up of heavy chain and  $\beta 2$  microglobulin
  - Recognises epitopes on linear peptides associated with MHC determinants
18. The advantage of degeneracy in codons is that
- It minimises the deleterious effects of mutations
  - It provides more flexibility
  - It helps to code proteins resistant to proteases
  - It helps to code proteins of very high molecular weight
19. The  $pK_a$ 's of lysine are given below.  
 $pK_a$  (COOH) = 2.2,  $pK_a$  ( $\alpha$ -NH $_3^+$ ) = 9.0,  
 $pK_a$  ( $\epsilon$ -NH $_3^+$ ) = 10.0  
 The pI of lysine is
- 7.07
  - 9.50
  - 6.10
  - 5.60
20. The molecular weight of a bacterial DNA molecule is  $2.64 \times 10^9$ . The average molecular weight of a nucleotide pair is 660. Assume that the average protein is made up of a chain of 400 amino acid residues. What is the maximum number of proteins that can be coded by the bacterial DNA molecule?
- 20000
  - 3333

- c. 6667  
d. None of the above
21. The coenzymes involved in the formation of Acetyl CoA from Pyruvate are
- Thiamine pyrophosphate, Lipoic acid and FAD
  - Pyridoxyl phosphate, Biotin and FAD
  - Vitamin B-12, Folic acid and Vitamin C
  - NADH, Lipoic acid and Vitamin E

### Common Data Questions

#### Common Data for Questions 22, 23 and 24:

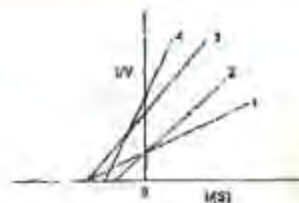
A restriction fragment, obtained with a type II endonuclease that recognises a six base pair site, was subjected to Maxam-Gilbert sequencing with results as shown in the autoradiogram below.

G	A+G	C	C+T
—	—		
	—		
			—
	—		
—	—		
	—		
			—
—	—		
	—		
		—	—
			—

22. The DNA sequence is
- $3'$  CTAGATAGTATAG  $5'$
  - $5'$  CTAGATAGTATAG  $3'$
  - $3'$  GATCTATCATATC  $5'$
  - $5'$  GATCATCATAC  $3'$
23. The restriction site is
- TAGCTA ATCGAT
  - TAGGTA ATCCAT
  - ATCCAT TAGGTA
  - GATACC CTATGG
24. Considering this DNA sequence as a template strand, the sequence of the corresponding mRNA is
- $5'$  CTAGATAGTATAG  $3'$
  - $3'$  GATCTATCATATC  $5'$
  - $3'$  GAUCUAUCAUAUC  $5'$
  - $5'$  CUAGAUAGUAUAG  $3'$

#### Common Data for Questions 25 and 26:

The kinetic data for all enzymatic reaction in the presence and absence of inhibitors are plotted in the following figure



25. Which line represents the kinetics without inhibitor?
- Line 1
  - Line 2
  - Line 3
  - Line 4
26. Which line represents kinetics of non-Competitive inhibition?
- Line 1
  - Line 2
  - Line 3
  - Line 4

**Linked Answer Questions: Q27.1 to Q28.2 carry two marks each**

#### Statement for Linked Answer Questions 27.1 and 28.2:

Transmission at many synapses in central nervous system is mediated by acetyl choline. Acetyl choline is cleaved to acetate and choline by the enzyme acetyl choline esterase which can be inhibited by diisopropyl phosphofluoridate (DIPF).

- 27.1 The mode of action of DIPF is by
- Modifying histidine residue
  - Covalently modifying a crucial serine residue
  - Inducing a conformational change in the protein
  - Forming a complex with choline
- 27.2 Based on its mode of action, DIPF is used as
- A therapeutic agent to treat neuro degenerative diseases
  - A nerve gas
  - As an agonist of acetyl choline
  - A reagent to determine the N-terminal amino acid

#### Statement for Linked Answer Questions 28.1 & 28.2:



The following fragments are isolated Oil partial hydrolysis of a nonapeptide X:

Val-Arg-Pro-Gly, Lys-Phe-Val-Arg, Ala-Gly-Ser-Lys

28.1 The correct sequence of X is

- (a) Ala-Gly-Ser-Lys-Ala-Pro-Val-Arg-Gly
- (b) Val-Arg-Gly-Lys-Phe-Val-Arg-Ala-Pro
- (c) Lys-Phe-Val-Arg-Ala-Gly-Ser-Pro-Gly
- (d) Ala-Gly-Ser-Lys-Phe-Val-Arg-Pro-Gly

28.2 The number of fragments obtained when X is digested with trypsin is

- (a) 0
- (b) 2
- (c) 3
- (d) 4

## J : BIOTECHNOLOGY

### ONE MARKS QUESTIONS (1-10)

1. Cells of meristemoid are best described as
  - a. differentiated and non dividing
  - b. dedifferentiated and dividing
  - c. differentiated and dividing
  - d. dedifferentiated and non dividing
2. Ultrafiltration process can not be used for
  - a. fractionation of proteins
  - b. desalting
  - c. harvesting of cells
  - d. selective removal of solvent
3. The number of replicons in a typical mammalian cell is
  - a. 40-200
  - b. 400
  - c. 1000-2000
  - d. 50000-100000
4. What product will result from complete hydrolysis of soluble dextran?
  - a. Sucrose only
  - b. Fructose only
  - c. Glucose and fructose Only
  - d. Glucose only
5. Aeration in a bioreactor is provided by
  - a. impeller
  - b. baffles
  - c. sparger

- d. all of the above
6. The transplastomic plants bear no risk for gene transfer through pollens as
    - a. the pollens degenerate before fertilization
    - b. the transformed mitochondrial DNA is lost during pollen maturation
    - c. the transformed chloroplast DNA is lost during pollen maturation
    - d. the transformed genomic DNA are inherited maternally
  7. The mobility of DNA in agarose gel electrophoresis is solely based on its
    - a. charge
    - b. conformation
    - c. size
    - d. none of the above
  8. Which of the following fluorescent probes is used to monitor the progress of amplification in Real time PCR?
    - a. SYBR green
    - b. Rhodamine
    - c. FITC
    - d. Cyan blue
  9. Expression of which of the following reporter genes do not require addition of specific substrate or detection?
    - a. Luciferase
    - b.  $\beta$ -Glucuronidase
    - c.  $\beta$ -Glucosidase
    - d. Green fluorescent protein
  10. Cibacron Blue dye affinity chromatography can be used for affinity purification of
    - a. NADPH dehydrogenase
    - b. glucoamylase
    - c. subtilisin
    - d. caspase

### TWO MARKS QUESTIONS (11-28)

11. A linear DNA fragment is 100% labeled at one end and has 3 restriction sites for EcoRI. If it is partially digested by EcoRI so that all possible fragments are produced, how many of these fragments will be labeled and how many will not be labeled?
  - a. 4 labeled; 6 unlabeled

- b. 4 labeled; 4 unlabeled  
 c. 3 labeled; 5 unlabeled  
 d. 3 labeled; 3 unlabeled
12. Match the following products with their starting substrates
- List I
- A. Sake  
 B. cider  
 C. wine  
 D. lager
- List II
1. apple juice  
 2. grape juice  
 3. bailey  
 4. rice
- |    | A | B | C | D |
|----|---|---|---|---|
| a. | 4 | 1 | 2 | 3 |
| b. | 1 | 4 | 2 | 3 |
| c. | 2 | 3 | 1 | 4 |
| d. | 3 | 4 | 2 | 1 |
13. Identify the following antibiotics with their modes of action.
- List I (Antibiotic)
- A. Ampicillin  
 B. Tetracycline  
 C. Nystatin  
 D. Anthramycin
- List II (Mode of action)
1. inhibition of protein synthesis  
 2. inhibition of cell wall synthesis  
 3. damage to cytoplasmic membrane  
 4. damage to DNA structure
- |    | A | B | C | D |
|----|---|---|---|---|
| a. | 1 | 2 | 4 | 3 |
| b. | 2 | 1 | 3 | 4 |
| c. | 1 | 2 | 3 | 4 |
| d. | 3 | 4 | 2 | 1 |
14. In a bioreactor baffles are incorporated to
- a. prevent vortex and to improve aeration efficiency  
 b. maintain uniform suspension of cells  
 c. minimize the size of air bubble for greater aeration  
 d. maintain uniform nutrient medium
15. Somatic embryo from cotyledon explant would develop in the following sequential stages,
- a. cotyledonary → heart → globular → torpedo  
 b. globular → torpedo → heart → cotyledonary  
 c. globular → heart → torpedo → cotyledonary  
 d. cotyledonary → globular → heart → torpedo
16. Though the right border (RB) and left border (LB) of T-DNA are identical, the DNA transfer is specific for the DNA left of the RB (the T-DNA), rather than for the DNA left of the LB because
- a. the sequence context at the RB defines the direction of transfer  
 b. the sequence context at the LB defines the direction of transfer  
 c. the nuclear location sequence (NLS) of VirD2 protein drives the excised T-strand  
 d. the endonuclease activity of VirD2 protein allows nicking at RB
17. Determine the correctness or otherwise of the following Assertion [A] and Reason [R]
- Assertion: An antigen recognized by one immunoglobulin subtype is not recognized by any other subtype.  
 Reason : Immunoglobulin subtypes differ from each other both in the variable and in the constant regions.
- a. Both [A] and [R] are true and [R] is the correct reason for [A]  
 b. Both [A] and [R] are true but [R] is not the correct reason for [A]  
 c. Both [A] and [R] are false  
 d. [A] is true but [R] is false
18. Identical sized RNA transcript is detected by Northern blot analysis of UDP glucuronosyl transferase obtained from human liver and kidney. Microarray analysis of the same samples shows equal spot intensity, whereas Western blot detects a 55kDa strong band in liver, but a very faint band in kidney of same size. The regulation of UDP glucuronosyl transferase is
- a. transcriptionally controlled  
 b. post-transcriptionally controlled  
 c. translationally controlled  
 d. post-translationally controlled



19. Match the items Column I with Column II:  
 Column I  
 A. Programmed cell death at site of infection  
 B. Hormone upregulated during flooding stress  
 C. Target for herbicide glyphosate  
 D. Pathogen-derived resistance  
 Column II  
 1. TMV coat protein  
 2. EPSP synthase  
 3. Hyper-sensitive response  
 4. Ethylene
- |    | A | B | C | D |
|----|---|---|---|---|
| a. | 1 | 2 | 4 | 3 |
| b. | 3 | 4 | 2 | 1 |
| c. | 1 | 4 | 2 | 3 |
| d. | 3 | 2 | 4 | 1 |

20. Using the Hill equation for an enzyme  $[S]_0 = (v_0 K_m / (V_{max} - v_0))^{1/n}$  and the plot of  $\log_{10} (v_0 / (V_{max} - v_0))$  vs  $\log_{10} [S]_0$  one can find out  
 A.  $V_{max}$  from the intercept on the ordinate  
 B.  $K_m$  from the intercept on the ordinate  
 C. 'n' from the slope  
 D.  $K_m$  from the intercept on the abscissa  
 a. A, B  
 b. B, C  
 c. C, D  
 d. A, D
21. Expression in poor amount and in inactive form of cDNA of a eukaryotic protein in Escherichia coli using its expression vector is due to  
 A. the absence of capping mechanism of mRNA  
 B. codon bias  
 C. absence of polyadenylation  
 D. absence of proper glycosylation  
 a. A, B  
 b. B, C  
 c. B, D  
 d. A, D

#### Common Data Questions

##### Common Data for Questions 22, 23 and 24:

A recombinant SV40 virus delivers c-myc cDNA, which has a unique Sal I site, into muscle cells. Southern analysis of Sal I digested total genomic

DNA of the muscle cells using c-myc cDNA probe generates a smear.

22. The DNA smear obtained on Southern blot is due to  
 a. head to head concatamer of viral DNA  
 b. head to tail concatamer of viral DNA  
 c. tail to tail concatamer of viral DNA  
 d. random integration of viral DNA
23. Western blot analysis of c-myc expression of such transformed cells last for  
 a. transiently  
 b. upto five generations  
 c. upto 10 generations  
 d. more than 100 generations
24. Which of the following types of cancer will be observed in such transformed cells?  
 a. Adenoma  
 b. Melanoma  
 c. Sarcoma  
 d. Hepatoma

##### Common Data for Questions 25, 26:

Normal primary hepatocytes can be artificially immortalized. Certain spontaneous mutants of immortalized hepatocytes are sensitive to ionizing radiation.

25. Which of the following genes are involved in immortalization of primary hepatocytes?  
 a. Telomerase and Cyclin D  
 b. NFkB and Thymidine kinase  
 c. Cyclin D and myc  
 d. Telomerase and Ras
26. What would happen to the mutant cells by ionizing radiation?  
 a. Apoptosis  
 b. Necrosis  
 c. Cell growth arrest  
 d. Cell proliferation

Linked Answer Questions: 27.1 to 28.2 carry two marks each.

##### Statement for Linked Answer Questions 27.1 and 27.2:

An aliquot of competent E. coli cells were used for determination of cell density by plate count method and another aliquot was used for transformation by plasmid DNA.

- 27.1 *E. coli* cell culture (1 ml) was diluted 1 : 1000000 and 200 $\mu$ l of this was used for plating. After 12h incubation of the plate, the number of colony forming units (CFU) was 150. What is the total CFU per ml in the original culture?
- $7.5 \times 10^8$
  - $1.5 \times 10^8$
  - $1.5 \times 10^6$
  - $3.0 \times 10^6$

- 27.2 Isolated plasmid DNA (5ng) was used for transformation of 100 $\mu$ l competent *E. coli* cells to which 900 $\mu$ l of SOC medium was added. An aliquot of 50 $\mu$ l was plated on a selective plate. After overnight incubation, 300 colonies were observed. Calculate the efficiency of transformation and the percentage of transformed cells per ml of parent culture
- $6.0 \times 10^3$  colonies per  $\mu$ g of plasmid DNA, 0.01%
  - $1.2 \times 10^5$  colonies per  $\mu$ g of plasmid DNA, 0.02%
  - $1.2 \times 10^6$  colonies per  $\mu$ g of plasmid DNA, 0.008%
  - $6.0 \times 10^6$  colonies per  $\mu$ g of plasmid DNA, 0.1%

**Statement for Linked Answer Questions 28.1 and 28.2:**

HMGCoA reductase that binds HMOCoA, is the major rate limiting step in the cholesterol biosynthetic path way. Several inhibitors of his enzyme are used as potential drugs. The assay of the enzyme is based on labeling the enzyme with radio labeled HMGCoA and counting (cpm) the labeled enzyme-substrate complex in the presence (test) and in the absence (control) of the inhibitor. A blank is set up that contains no enzyme.

- 28.1 The per cent inhibition on this enzyme is calculated Imm lie equation
- $\{[\text{cpm (control)} - \text{cpm (test)}] / [\text{cpm (control)} - \text{cpm (blank)}]\} \times 100$
  - $\{[\text{cpm (control)} - \text{cpm (test)}] / [\text{cpm (blank)} - \text{cpm (control)}]\} \times 100$
  - $\{[\text{cpm (test)} - \text{cpm (control)}] / [\text{cpm (control)} - \text{cpm (blank)}]\} \times 100$
  - $\{[\text{cpm (control)} - \text{cpm (blank)}] / [\text{cpm (test)} - \text{cpm (control)}]\} \times 100$

- (test) – cpm (control)]  $\times 100$
- 28.2 An inhibitor is considered active if it causes more than 65% inhibition. The cpm values respectively of control, test and blank samples for inhibitors W, X, Y and Z are given below. State which of the inhibitors is active.
- X – 8000, 4000 and 100
  - W – 7000, 1400 and 135
  - Y – 7500, 5000 and 90
  - Z – 7200, 2800 and 200

**K : BOTANY**

**ONE MARKS QUESTIONS (1-10)**

- For the formation of embryo sac the functional megaspore undergoes
  - Three meiotic division
  - Three mitotic division
  - two mitotic division
  - Two meiotic division
- How many nucleosomes per turn are present it in a 30 nm chromatin fibre?
  - 4
  - 8
  - 6
  - 10
- The process by which water undergoes a phase transition from liquid state to an amorphous glassy state is known as
  - Desiccation
  - Vitrification
  - Ice nucleation
  - Hyperhydricity
- The term 'somaclonal variation' was coined by
  - Murashige and Skoog
  - Karp and Maddock
  - Gamborg and Phillips
  - Larkin and Scowcroft
- Storage and transport of lipid occurs in
  - Glyoxysomes
  - Peroxisomes
  - Lysosomes
  - Spherosomes
- The drug morphine is obtained from which plant part of *Papaver somniferum* ?



- a. Leaf  
b. Stem  
c. Capsule  
d. Root
7. The floristic region of the world are determined on the basis of geographical distribution of plant genera. Identify the correct reason for his speciation
- a. Climate change  
b. Genetic variation  
c. Population distribution  
d. Ecotypic variation
8. Pericycle is regarded as
- a. The origin of lateral root and it is located between the endodermis and vascular bundle  
b. Internal ground tissue present at the central position of the organ limited by the vascular bundles  
c. Parenchymatous ground tissues passing in between the vascular bundles  
d. The layer next to epidermis and solely consists of primary tissues
9. Apospory can be defined as
- a. Development of sporophytes on the gametophytes without any reduction division  
b. Development of gametophytes on the sporophytes without any reduction division  
c. Development of several embryo within the same ovule  
d. Development of an embryo directly from an egg cell or male gamete
10. The synonym of the families Labitae, Umbelliferae, Compositae and Grammeae are :
- a. Leguminaceae, Acantheceae, Asteraceae, Lamiaceae  
b. Solanaceae, Aricaceae, Apiaceae, Poaceae  
c. Lamiaceae, Apiaceae, Asteraceae, Poaceae  
d. Lilliaceae, Cucerbitaceae, poaceae, Asteraceae
11. The following features outline a system of plant classification
- Unisexual flowers are the most primitive within the angiosperms
  - Polyphyletic origin of angiosperms
  - Monocotyledons have been considered more primitive than dicotyledons
- Which one of the following systems of classification represents above feature?
- a. Linnaeus  
b. Engler and Prantl  
c. Rendle  
d. Hutchinson
12. Following are the features of one type of C4 mechanism
- The mitochondrion is responsible for malate decarboxylation
  - The mesophyll cell tends to form aspartate rather than malate, from oxaloacetate
  - Presence of double bundle sheath
- Identify the correct one.
- a. NADP-ME type  
b. PCK-type  
c. NAD-ME type  
d. CAM-type
13. Which one of the following statements is not true for marker-assisted selection?
- a. The ability to manipulate recessive genes and identify the heterozygotes  
b. A reduction in phenotypic screening and in the number of backcrosses  
c. Without the self-fertilization of individual, heterozygotes cannot be identified  
d. An easy detection of superior lines along with the ability to select multiple traits simultaneously
14. Following are the symptoms of a disease in potato
- Small, isolated, scattered, pale brown spots on the leaflets
  - The lowest leaves are attacked first and the disease progresses upwards
  - In the necrotic spots, concentric rings appear on the older leaves and darkened areas on the stem
- There is usually a narrow chlorotic zone around the spots which fades into normal

green and increases with an increase in the size of the spots

Identify the disease, which manifests these symptoms

- Early blight of potato
  - Wart disease of potato
  - Brown rot of potato
  - Late blight of potato
15. The two important biochemical reactions of nitrogen metabolism are shown below
- $$\text{NO}_2^- + 8\text{H}^+ + 6\text{e}^- \xrightarrow{\text{ENZYME}} \text{NH}_4^+ + 2\text{H}_2\text{O}$$
- $$\text{Glutamate} + \text{NH}_3 + \text{ATP} + \text{Mg}^{2+} \xrightarrow{\text{ENZYME}} \text{Glutamine} + \text{ADP} + \text{Pi}$$
- Which one of the following pairs of enzymes is correct for the above reactions respectively?
- Nitrite reductase and Glutamate dehydrogenase
  - Nitrate reductase and Glutamine synthetase
  - Nitrite reductase and Glutamine synthetase
  - Nitrite reductase and glutamate synthase
16. The functions of vir D2 protein in plant are
- Nuclear targeting and protection of 5' end of T-DNA
  - Sensing phenolic kinase and induction of phosphorylation
  - Nicking and processing of T-DNA
  - Synthesis of transfer apparatus and regulation of cell cycle
17.  $\text{O}_2 \rightarrow \text{}^1\text{O}_2 \rightarrow \text{X} \rightarrow \text{Y}$   
In the given stepwise reduction of  $\text{O}_2$ , choose the correct sequence of reactive oxygen species formed marked as 'X' and 'Y'
- $\text{}^1\text{O}_2 \rightarrow \text{}^{\bullet}\text{OH}$
  - $\text{H}_2\text{O}_2 \rightarrow \text{}^{\bullet}\text{OH}$
  - $\text{}^{\bullet}\text{O}_2 \rightarrow \text{H}_2\text{O}_2$
  - $\text{}^{\bullet}\text{OH} \rightarrow \text{}^{\bullet}\text{O}_2$
18. In a three point test cross  $\text{XYZ}/\text{xyz} \times \text{xyz}/\text{xyz}$ , the following data are obtained:
- |     |     |     |     |     |     |     |     |
|-----|-----|-----|-----|-----|-----|-----|-----|
| XYZ | xyz | Xyz | xYZ | XyZ | xyZ | XyZ | xYz |
| 476 | 471 | 15  | 18  | 9   | 9   | 1   | 1   |
- Find out the distance between X and V genes
- 5 cM
  - 3 cM

c. 8 cM

d. 2 cM

Q.19 – 26 are matching exercises. Choose the correct one from among the alternates a, b, c and d

19. Group I (Type of interaction)
- Recessive epistasis
  - Dominant epistasis
  - Duplicate recessive epistasis
  - Dominant and recessive epistasis
- Group II ( $F_2$  Phenotypic ratio)
- 12 : 3 : 1
  - 13 : 3
  - 9 : 6 : 1
  - 9 : 3 : 4
  - 9 : 7
  - 15 : 1
- |    | A | B | C | D |
|----|---|---|---|---|
| a. | 2 | 1 | 2 | 5 |
| b. | 4 | 1 | 5 | 2 |
| c. | 6 | 3 | 2 | 1 |
| d. | 1 | 5 | 3 | 4 |
20. Group I (Secondary metabolite)
- Coniine
  - Morphine
  - Quinine
  - Chalcone
- Group 2 (Precursor)
- Tryptophan
  - Phenylalanine
  - Lysine
  - Tyrosine
  - Ornithine
  - Agmatine
- |    | A | B | C | D |
|----|---|---|---|---|
| a. | 1 | 5 | 3 | 4 |
| b. | 3 | 4 | 1 | 2 |
| c. | 2 | 1 | 2 | 3 |
| d. | 4 | 3 | 6 | 5 |
21. Group I (Plant product)
- Hing
  - Dalchini
  - Saffron
  - Kattha
- Group II (Plant species)
- Cinnamomum zeylanicum
  - Acacia catechu.



3. *Ferula asafoetida*
4. *Acacia nilotica*
5. *Cinnamomum tamala*
6. *Crocus sativus*

	A	B	C	D
a.	1	3	6	4
b.	4	2	3	1
c.	3	1	6	2
d.	2	4	5	3

## 22. Group I (Enzymes)

- A. Glycogen phosphorylase
- B. Hexokinase
- C. Pyruvate carboxylase
- D. RuBP carboxylase

## Group II (Pathways)

1. Glycolytic pathways
2. Calvin cycle
3.  $C_3$  cycle
4.  $C_4$  cycle
5. Glycogenolysis
6.  $C_6$  cycle

	A	B	C	D
a.	5	1	6	3
b.	4	2	5	1
c.	2	1	3	4
d.	6	5	2	1

## 23. Group I (Inflorescence)

- A. Raceme
- B. Catkin
- C. Cyathium
- D. Verticillaster

## Group II (Plant genera)

1. *Poinsettia*
2. *Ocimum*
3. *Raphanus*
4. *Calotropis*
5. *Ficus*
6. *Salix*

	A	B	C	D
a.	1	4	3	5
b.	3	6	1	2
c.	2	5	3	1
d.	4	3	1	6

## 24. Group I (Hormone)

- A. Gibberellin
- B. IAA
- C. Cytokinin

## D. Ethylene

## Group II (Functions)

1. Phototropism and gravitropism
2. Stomatal movement
3. Delay of senescence
4. Combating water deficit
5. Seed germination
6. Ripening of fruits

	A	B	C	D
a.	6	4	1	2
b.	5	1	3	6
c.	3	4	5	1
d.	4	3	1	5

## 25. Group I (In vitro problems)

- A. Browning of explants
- B. Hyperhydricity of regenerated shoots
- C. Low frequency of formation or protoplast colonies
- D. Low transformation frequency during biolistic operation

## Group II (Remedial measure)

1. Addition of antioxidants in the medium
2. Nurse culture
3. Osmotic pretreatment of tissues
4. Membrane raft culture
5. Decrease agar concentration
6. Depletion of  $CO_2$  in the culture vessel

	A	B	C	D
a.	2	3	5	4
b.	3	2	4	6
c.	1	4	2	3
d.	4	3	1	6

## 26. Group I (Plant disease)

- A. Bunt of rice
- B. Stem rot of jute
- C. Ergot of rye
- D. Ring rot of potato

## Group II (Causal organism)

1. *Macrophomina phaseolina*
2. *Cercospora personata*
3. *Tilletia barclayana*
4. *Xanthomonas oryzae*
5. *Claviceps purpurea*
6. *Corynebacterium sepidonicum*

	A	B	C	D
a.	1	4	4	3
b.	3	4	5	6

c.	2	5	3	5
d.	4	3	2	1

**Linked Answer Questions:** 27.1 to 28.2 carry two marks each.

**Statement for Linked Answer Questions 27.1 and 27.2:**

In tomato the following genes are located on chromosome 3:

- + tall plant                      d dwarf plant
- + normal leaves                m mottled leaves
- + smooth fruit                 p pubescent fruit

Results of the cross

+++/dmp X dmp/dmp were

+++ 430    dmp 452    +mp 45    d++ 38  
 ++p 16    dm+ 17    +m+ 1    d+p 1

27.1 Which one of the following progeny groups represents double crossovers?

- (a) +mp / d++
- (b) ++p / dm+
- (c) +m+ / d+p
- (d) +++ / dmp

27.2 What would be the value of coincidence?

- (a) 0.25
- (b) 0.48
- (c) 0.66
- (d) 0.82

**Statement for linked answer questions Q.28.1 & Q.28.2 :**

Two proteins having same molecular weight of 1,92,000 dalton were identified. During post-translational modification one of the proteins is phosphorylated.

28.1 What will be the nature of the band(s) if the mixture of these proteins is separated in electrophoretic gel?

- (a) Single band
- (b) Distinct two bands
- (c) No band(s) at all
- (d) Bands with a number of subunits

28.2 For further separation of these two proteins what method one should adopt?

- (a) 2-D gel electrophoresis
- (b) Gel filtration chromatography
- (c) Native gel electrophoresis
- (d) Reverse phase chromatography

## L : MICROBIOLOGY

### ONE MARKS QUESTIONS (1-10)

- The scientists who discovered restriction endonucleases are
  - Temin and Baltimore
  - Arber and Smith
  - Gilbert and Sanger
  - Loderberg and Tatum
- The virus responsible for the "Severe Acute Respiratory Syndrome" (SARS) is a
  - Picornavirus
  - Coronavirus
  - Adenovirus
  - Influenza virus
- Denitrification process carried out by a few groups of bacteria reduces nitrate ( $\text{NO}_3^-$ ) to nitrogen ( $\text{N}_2$ ) gas. How many electrons per nitrogen atom are transferred to nitrate in this process
  - 2
  - 3
  - 4
  - 5
- Metabolic yield of a product being produced by an industrially important microorganism is defined as
  - gram product formed / gram substrate consumed
  - gram product formed / gram cells formed
  - gram product formed / litre of culture broth
  - gram product formed / (litre . hour)
- Which the Following features can distinguish Bacteria and Archea ?
  - Absence of the membrane-enclosed nucleus
  - Absence of internal membranous organelles
  - The type of glycosidic bonds present in the peptidoglycan layer (or its equivalent) of the cell wall
  - Presence of N-acetylglucosamine in the peptidoglycan layer (or its equivalent) of the cell wall



6. Which of the following feature is not exhibited by green sulphur photosynthetic bacteria
- Presence of bacteriochlorophylls
  - Sulphur deposition outside the cell wall
  - Oxygenic mode of photosynthesis
  - Non motile nature of cells
7. The microorganisms which obtain energy from the oxidation of inorganic compounds are known as
- Photoautotrophs
  - Chemolithotrophs
  - Photoheterotrophs
  - Chemoorganotrophs
8. Neutrophiles exchange potassium for proton using
- Antiport transport system
  - Symport transport system
  - ABC transport system
  - Group Translocation
9. Amphotericin B selectively disrupts the cell membrane of fungi because of its high affinity for a compound present in fungal membrane. The name of this compound is
- Ergosterol
  - Mannitol
  - Miconazole
  - Clotrimazole
10. Which of the following 'hepatitis virus' has DNA genome
- Hepatitis A
  - Hepatitis B
  - Hepatitis C
  - Hepatitis E

### TWO MARKS QUESTIONS (11-28)

11. Which of the following groups of microorganisms contain both superoxide dismutase and catalase enzymes for growth?
- Obligate aerobes only
  - Facultative anaerobes only
  - Strict anaerobes only
  - Both obligate aerobes and facultative anaerobes
12. Which of the following is not responsible for making bacteria resistant to penicillin action
- Change in the penicillin binding proteins
  - Inability of penicillin to reach its site of action
  - Inability to bind to 30S ribosomal subunit
  - Presence of plasmid coding for penicillinase
13. Match the correct combination of the antibiotic and the microorganism producing it
- | Antibiotic         | Microorganism                       |
|--------------------|-------------------------------------|
| A. Vancomycin      | 1. <i>Bacillus subtilis</i>         |
| B. Bacitracin      | 2. <i>Cephalosporium acremonium</i> |
| C. Chloramphenicol | 3. <i>Streptomyces orientalis</i>   |
| D. Streptomycin    | 4. <i>Penicillium chrysogenum</i>   |
|                    | 5. <i>Streptomyces venezuelae</i>   |
|                    | 6. <i>Streptomyces griseus</i>      |
- a.      A      B      C      D  
 a.      3      1      5      6  
 b.      1      4      6      3  
 c.      5      3      6      4  
 d.      6      3      5      2
14. The pathogenesis associated with *Vibrio cholerae* infection depends on the colonization of the small intestine by the organism and secretion of an enterotoxin. Which of the following statement related to pathogenicity of cholera is incorrect?
- Vibrio cholerae* secretes the enterotoxin cholera toxin
  - Cholera toxin consists of A (active) and B (binding) subunit
  - Cholera toxin alone cannot reproduce the symptoms of cholera in the absence of *Vibrio cholerae*
  - CTX bacteriophage carries the genes of cholera toxin and other virulence factors
15. Prior infection of *Mycobacterium tuberculosis* can be detected by positive by tuberculin skin test result. The basis of this test is
- Anaphylactic hypersensitivity (Type I)
  - Antibody dependent cytotoxic hypersensitivity (Type II)



- c. Immune complex mediated hypersensitivity (Type III)  
 d. Cell mediated or delayed hypersensitivity (Type IV)
16. A bacterial culture on being transferred from anaerobic to aerobic condition of growth drastically reduce the rate of glucose catabolism. This regulatory phenomenon is known as  
 a. Tyndallization  
 b. Pasteurization  
 c. Crabtree effect  
 d. Pasteur effect
17. Which of the following statements related to 'High Frequency recombination' (Hfr) cells is incorrect  
 a. Single strand of DNA that enters into recipient F cell contains a piece of the F factor at the leading end followed by the bacterial chromosomes and then by the remainder of the F factor  
 b. Most mating results in the transfer of only a portion of donor chromosome because the attachment between the two cells can break  
 c. The bacterial genes adjacent to the leading piece of the F Factor are least frequently transferred  
 d. The donor cell genes that are transferred vary, since the F plasmid can integrate at several different sites in a bacterial DNA
18. Replication of the positive strand genome of poliovirus requires  
 a. Reverse Transcriptase  
 b. Virus encoded RNA dependent RNA polymerase  
 c. DNA dependent RNA polymerase  
 d. DNA polymerase
19. Which of the following statement about bacteriophage  $\lambda$  is incorrect?  
 a. It initially produces two proteins; one acts as an inhibitor of  $\lambda$  repressor synthesis and the other acts as a terminator for transcription.  
 b. It maintains its lysogenic state in the absence of an inducer  
 c. In switching from the lysogenic to the lytic phase, it turns off the synthesis of  $\lambda$  repressor because cro protein binds to  $\lambda$  operator  $O_R3$

- d. It forms N and Q gene products which act as positive regulatory proteins leading to the sequential production of  $\lambda$  encoded proteins

20. While evaluating the effectiveness of a disinfectant (X) against *Salmonella typhi* by the 'Phenol-Coefficient Method' the following data were obtained

Disinfectant (X)	Dilution	Subculture Tubes		
		5 min	10 min	15 min
	1:50	0	0	0
	1:100	+	0	0
	1:150	+	0	0
	1:175	+	+	0
	1:200	+	+	+
Phenol	1:90	+	0	0
	1:100	+	+	+

0 = no growth, + = growth

The Phenol-Coefficient of the disinfectant (X) would be

- a. 1.66  
 b. 3.32  
 c. 0.50  
 d. 1.00
21. Lactic acid bacteria ferment glucose to produce two moles of lactic acid. What is the net yield of ATP and NADH per mole of glucose?  
 a. 2 ATP and 2 NADH  
 b. 2 ATP and 0 NADH  
 c. 4 ATP and 2 NADH  
 d. 4 ATP and 0 NADH

### Common Data Questions

#### Common Data for Questions 22, 23 and 24:

Analysis of the electron transport system in a newly isolated aerobic Gram-positive bacterium showed the existence of five electrons of five transport molecules. Their redox potentials are as follows:

Oxidant	Reductant	Electrons transferred	$E_0'$ (volts)
P	$\text{P}^{\text{H}}$	2	-0.13
$\text{NAD}^+$	NADH	2	-0.32
R	$\text{R}^{\text{H}}$	2	-0.02
Cytochrome c (+2)	Cytochrome c (+1)	1	+0.22
S	$\text{S}^{\text{H}}$	2	+0.69

Family constant (F) = 22 kcal/(volt.mole)

22. Which of the following sequence of the electron transport carriers would be involved in the transport of electrons for energy generation?  
 a.  $\text{P} \rightarrow \text{NAD}^+ \rightarrow \text{R} \rightarrow \text{Cytochrome c} \rightarrow \text{S}$   
 b.  $\text{NAD}^+ \rightarrow \text{P} \rightarrow \text{R} \rightarrow \text{Cytochrome c} \rightarrow \text{S}$   
 c.  $\text{NAD}^+ \rightarrow \text{P} \rightarrow \text{Cytochrome c} \rightarrow \text{R} \rightarrow \text{S}$   
 d.  $\text{NAD}^+ \rightarrow \text{Cytochrome c} \rightarrow \text{P} \rightarrow \text{R} \rightarrow \text{S}$



23. If the electrons are transferred from NADH to S, the difference in redox potential would be
- + 0.95
  - + 0.76
  - 0.95
  - 0.76
24. What would be the value of standard Free energy change for the transfer of electrons from  $\text{PH}_2$  to S?
- 17.5 kcal/mol
  - 35.0 kcal/mol
  - + 17.5 kcal/mol
  - + 35.0 kcal/mol

**Common Data for Questions 25, 26:** *E. coli* can metabolize both glucose and lactose sugars as sole source of carbon and energy. While glucose catabolizing enzymes are constitutive, lactose catabolizing enzymes, are induced in the presence of compounds such as lactose, IPTG, etc. Lactose catabolizing enzymes are also regulated by catabolite repression.

25. Assume that *E. coli* has been grown in a nutrient medium containing lactose only. When the culture has reached the logarithmic phase of growth, the cells are harvested and transferred to medium containing glucose only. Would you expect the culture to
- Continue to grow in its logarithmic phase
  - Exhibit a lag phase first and then grow again in its logarithmic phase
  - Undergo lysis
  - Stop growth
26. If the *E. coli* cells are grown in a medium containing both glucose and lactose, what is likely to happen?
- Both the sugars would be utilized simultaneously
  - The culture will exhibit synchronous growth
  - Lactose will be utilized first followed by glucose
  - Glucose will be utilized first followed by lactose

**Linked Answer Questions: 27.1 to 28.2** carry two marks each.

**Statement for Linked Answer Questions 27.1 and 27.2:**

Consider a nutrient medium containing  $2 \times 10^4$  cells. The culture is incubated at  $25^\circ\text{C}$  under aerobic conditions or growing the cells. The generation time of the cells is 40 minutes.

- 27.1 If the culture is allowed to grow for 8 hours, how many generations would have taken place?
- 8
  - 12
  - 16
  - 24
- 27.2 What will be the cell population after 8 hours?
- $4.1 \times 10^5$
  - $8.2 \times 10^6$
  - $4.1 \times 10^7$
  - $8.2 \times 10^7$

**Statement for Linked Answer Questions 28.1 and 28.2:**

A mutant of *E. coli* was found which did not synthesize  $\beta$ -galactosidase in the presence as well as in the absence of the inducer, IPTG. The investigation revealed that the structural genes of the lac operon were unaltered in the mutant, but one of the controlling genes (I or O) was mutated. The different allelic forms of the regulator gene and lac operator gene are as follows

$I^+$  - Wild type regulator gene

$I^C$  - Constitutive regulator

$I^S$  - Repressor form which is insensitive to inducer

$O^+$  - Wild type operator gene

$O^C$  - Constitutive operator

- 28.1 Which of the following mutation in the controlling genes was responsible for the above mentioned behaviour of the *E. coli* mutant?
- $I^- O^+$
  - $I^C O^+$
  - $I^S O^+$
  - $I^+ O^C$
- 28.2 On further mutation, the *E. coli* mutant synthesized  $\beta$ -galactosidase in the presence of the inducer only. Which of the following mutant form would explain this observation?

- (a)  $I^+ O^+$   
 (b)  $I^+ O^c$   
 (c)  $I^h O^+$   
 (d)  $I^h O^c$

## M : ZOOLOGY

### ONE MARKS QUESTIONS (1-10)

- The fur color of a newly identified species of dog is either white or red and is controlled by a single gene with two alleles. In a genetic experiment, a red dog was mated with a white dog. The white to red ratio among the offspring was 1 : 1. What is the genotype of the parent with the red fur?
  - Heterozygous
  - Homozygous for the dominant allele
  - Homozygous for the recessive allele
  - Insufficient data to decide
- Which one of the following is NOT true regarding human reproduction?
  - Oestrogen has both positive and negative feedback effects on the pituitary gland.
  - Corpus luteum produces progesterone.
  - Progesterone is essential to maintain the structure of the endometrium.
  - Chorionic gonadotrophin is secreted by corpus luteum if fertilization occurs.
- Which one of the following statements is true?
  - All vertebrates contain amnion.
  - All chordates are vertebrates.
  - All tunicates are chordates.
  - Cephalochordates are characterized by the presence of a well defined skull.
- The body plan common to both annelids and insects is \_\_\_\_\_.
  - Acoelomate
  - Pseudocoel
  - Coelom
  - Homocoel
- Which one of the following is an anatomical feature unique to marine and desert mammals?
  - Four-chambered heart
  - Long kidney loops
  - Waterproof skin
  - Very small kidneys
- Which one of the following is the most useful method to determine the evolutionary distance between two closely related species?
  - Comparison of anatomical structures
  - Comparison of the DNA sequences of the exons of conserved genes
  - Comparison of the intronic sequences
  - Fossil records
- Hydrostatic skeleton is one of the characteristics of \_\_\_\_\_.
  - Onychophorans
  - Jelly Fish
  - Nematodes
  - Sponges
- Rearrange the Following taxonomic terms in the correct hierarchical order.  
 ORDER - FAMILY - PHYLUM - CLASS
  - FAMILY - PHYLUM - CLASS - ORDER
  - PHYLUM - ORDER - CLASS - FAMILY
  - CLASS - PHYLUM - FAMILY - ORDER
  - PHYLUM - CLASS - ORDER - FAMILY
- The following is a list of animals and their geographical distribution. Among the options, choose the one that matches the animals to their correct geographical distribution.  
 List I (Animals)  
 A. Tardigrades  
 B. Snail  
 C. Peripatus  
 D. Oyster  
 List II (Geographical distribution)  
 1. Ocean  
 2. Leaf litter  
 3. Fresh water  
 4. Moist soil
 

	A	B	C	D
a.	4	3	2	1
b.	3	2	1	4
c.	2	2	4	3
d.	3	4	2	1
- Which one of the following anatomical feature enables the sessile life style of sea-squirts ?
  - Endostyle



- b. Otolith
- c. Branchial basket
- d. Solenocytes

### TWO MARKS QUESTIONS (11-26)

11. Which one of the following is a true statement?
- a. The embryos of higher organisms resemble the adults of lower organisms.
  - b. Intestine develops from the germ layer called endoderm.
  - c. Blood vessels develop from somites.
  - d. All the brain cells develop from mesoderm.
12. The following paired terms are not correctly paired. Which one of the four options is the correct pairing?
- A. Hedgehog signaling
  - B. wnt signaling
  - C. Notch signaling
  - D. Hox genes
1. Anterior – posterior axis duplication
  2. Cyclopic eye of lambs
  3. Vertebrate limb development
  4. Nematode germ cell proliferation
- |    | A | B | C | D |
|----|---|---|---|---|
| a. | 1 | 2 | 3 | 4 |
| b. | 3 | 4 | 1 | 2 |
| c. | 4 | 1 | 2 | 3 |
| d. | 2 | 1 | 4 | 3 |
13. Which one of the following gives rise to bone?
- a. Somites
  - b. Osteoclasts
  - c. Chondrocytes
  - d. Osteocytes
14. The Michaelis-Menton constant  $K_m$  is measure of \_\_\_\_\_.
- a. The rate of the reaction
  - b. The affinity of the enzyme for the substrate
  - c. The concentration of the enzyme-substrate (ES) intermediate
  - d. None of the above
15. Which one of he following is the major force of attraction that stabilizes the three dimensional structure of globular proteins?
- a. Peptide bond
  - b. Van der Waal's interactions
  - c. Hydrogen bonds
  - d. Hydrophobic interactions between the side chains
16. The histone H1 is present in the \_\_\_\_\_
- a. Linker region
  - b. Nucleosome
  - c. Nucleolus
  - d. hnRNPs
17. Proper execution of cell division cycle is ensured by \_\_\_\_\_
- a. Apoptosis
  - b. DNA polymerases
  - c. Cyclins
  - d. Proteins of the cell cycle checkpoints
18. The following is a list of subcellular structures and their junctions. Choose the option the correctly matches tile subcellular structures to their functions.
- A. Tonoplast
  - B. Peroxisomes
  - C. Endosome
  - D. Proteasome
1. Lipid biosynthesis
  2. Protein degradation
  3. Storage of starch
  4. Removal of free radicals
- |    | A | B | C | D |
|----|---|---|---|---|
| a. | 1 | 2 | 3 | 4 |
| b. | 3 | 4 | 1 | 2 |
| c. | 3 | 4 | 2 | 1 |
| d. | 1 | 2 | 4 | 3 |
19. Choose the correct statement
- a. The endosymbiotic theory views that organelles like mitochondria were once free living organisms.
  - b. Endosymbiotic theory states that bacteria, like *E. coli*, were once endoparasites.
  - c. Endosymbiotic theory states that endosperms are prone to parasitic bacterial infection.
  - d. Endosymbiotic theory states that endospores exist in symbiotic association with bacteria.
20. Cohort is defined as \_\_\_\_\_.
- a. Individuals in a population with all of very different age.
  - b. Individuals in a population with approximately same age.

- c. Individuals belonging to different species of animals.  
 d. Individuals exhibiting most diverse behaviour in a population.
21. The neotropic biogeographical region for terrestrial species includes \_\_\_\_\_.
- India and Indonesia
  - Southern Africa
  - South America
  - Australia
22. Pseudocoelomate body cavity is found in \_\_\_\_\_.
- Caenorhabditis elegans
  - Octopus vulgaris
  - Fasciola hepatica
  - Lumbricus terrestris
23. Asexual reproduction by longitudinal binary fission occurs in the protozoan \_\_\_\_\_.
- Paramecium
  - Plasmodium
  - Amoeba
  - Trypanosoma
24. According to fossil history, Hyracotherium is an ancestor of \_\_\_\_\_.
- Hayena
  - Horse
  - Elephant
  - Lion
25. Immunoglobulin IgG has 4 chains held by disulphide bonds. The maximum number of different amino acids present at the C terminal end of a monoclonal IgG is \_\_\_\_\_.
- 1
  - 2
  - 3
  - 4
26. There is a change of concentration of ions during formation of urine, the concentration in urine being higher than that in plasma in healthy humans. The correct order of change in ion concentration between plasma and urine is \_\_\_\_\_.
- $\text{NH}_4^+ > \text{PO}_4^{3-} > \text{K}^+ > \text{Na}^+$
  - $\text{PO}_4^{3-} > \text{K}^+ > \text{Na}^+ > \text{NH}_4^+$
  - $\text{NH}_4^+ > \text{PO}_4^{3-} > \text{Na}^+ > \text{K}^+$
  - $\text{Na}^+ > \text{K}^+ > \text{PO}_4^{3-} > \text{NH}_4^+$

**Linked Answer Questions: 27.1 to 28.2 carry two marks each.**

**Statement for Linked Answer Questions 27.1 and 27.2:**

Assume genes a, b and c are on the same chromosome. In a mating experiment to map the relative positions of these three genes, the following results were obtained:

- Out of 500 progenies of the parents with the genotype  $a(-) b(-) / a(+) b(+)$ , 20 were  $a(-) b(-) / a(-) b(+)$ .
  - Out of 1000 progenies of the parents with the genotype  $a(-) c(-) / a(+) c(+)$ , 80 were  $a(-) c(-) / a(+) c(-)$ .
- 27.1 What are the frequencies of recombination between a and b, and between a and c?
- 8 and 4
  - 24 and 12
  - 4 and 8
  - 12 and 24
- 27.2 Which one of the following is definitely true in terms of the relative map positions?
- a is closer to c than to b
  - a is closer to b than to c
  - b is closer to a than to c
  - c is closer to b than to a

**Statement for Linked Answer Questions 28.1 and 28.2:**

Assume that a population meets Hardy-Weinberg conditions, where p and q are dominant and recessive alleles.

- 28.1 Which of the following equations can be used to determine the genotype frequencies
- $p + q = 1$
  - $p^2 + 2pq + q^2 = 1$
  - $pp \times q = 1$
  - $(p + q)(p - q) = 1$
- 28.2 In a population where 1% of people are homozygous recessive, the percentage of people with heterozygous genotype is \_\_\_\_\_.
- 90%
  - 9%
  - 10%
  - 18%