

LIFE SCIENCES

I: CHEMISTRY (COMPULSORY)

ONE MARKS QUESTIONS (1-25)

For each question given below, four alternative answers are provided of which only one is correct. Write the correct answer in the answer book by writing a, b, c or d along with the corresponding sub-question number

(25 × 1 = 25)

1. In CsCl crystal structure, each Cs^+ ion is surrounded by
 - a. 4Cl^-
 - b. 6Cl^-
 - c. 8Cl^-
 - d. 12Cl^-
2. $\text{Cr}(\text{NH}_3)_3\text{Cl}_3$ reacts with AgNO_3 solution quantitatively. The number of moles of AgNO_3 consumed by one mole of the metal complex is
 - a. 1.0
 - b. 2.0
 - c. 3.0
 - d. 4.0
3. Bohr model can explain
 - a. the spectrum of hydrogen atom only.
 - b. the solar system
 - c. the spectrum of hydrogen molecule.
 - d. the spectrum of an atom or an ion containing only one electron.
4. The hybridization of oxygen in the molecule OF_2 is
 - a. sp
 - b. sp^2
 - c. sp^3
 - d. dsp^2
5. The correct increasing order of electro negativity of the following elements is
 - a. $\text{F} < \text{O} < \text{N} < \text{S}$
 - b. $\text{S} < \text{N} < \text{O} < \text{F}$
 - c. $\text{N} < \text{S} < \text{O} < \text{F}$
 - d. $\text{O} < \text{N} < \text{S} < \text{F}$
6. Which of the following trihalides of nitrogen is least basic?
 - a. NF_3
 - b. NCl_3
 - c. NBr_3
 - d. NI_3
7. Which of the following compounds has the highest pH when dissolved in water?
 - a. CH_3COONa
 - b. NH_4Cl
 - c. NaCN
 - d. NaCl
8. Which of the following reactions will give oxygen?
 - a. $\text{NaOH} + \text{F}_2$
 - b. $\text{NaOH} + \text{Cl}_2$
 - c. $\text{NaOH} + \text{Br}_2$
 - d. $\text{NaOH} + \text{I}_2$
9. When 1-butyne is treated with sulphuric acid in the presence of mercuric sulphate, the stable product formed is
 - a. Butyl sulphate
 - b. Butan-2-one
 - c. 2-Buten-1-ol
 - d. Butynediol
10. The compound that will not give chloroform on treatment with Cl_2/NaOH is
 - a. Propanone
 - b. Ethanol
 - c. Ethanal
 - d. Propanol
11. Most reactive compound towards formation of cyanohydrin on treatment with KCN followed by acidification is
 - a. Benzaldehyde
 - b. p-Nitrobenzaldehyde
 - c. Phenylacetaldehyde
 - d. p-Hydroxy benzaldehyde

12. The compound with highest pK_a is expected to be
- p-Nitrophenol
 - p-Chlorophenol
 - p-Methylphenol
 - p-Methoxyphenol
13. The method that would provide the highest yield of pure ethylbenzene is the reaction of benzene with
- ethanol and sulphuric acid.
 - ethyl chloride in the presence of aluminium chloride
 - acetyl chloride in the presence of aluminium chloride followed by reduction with $LiAlH_4$.
 - ethanoyl chloride in the presence of aluminium chloride.
14. Most reactive halide towards SN_1 reaction is
- n-Butyl chloride
 - sec- Butyl chloride
 - tert - Butyl chloride
 - Allyl chloride
15. Aldol condensation will not be observed in
- Chloral
 - Phenyl acetaldehyde
 - Cyclohexenal
 - Nitromethane
16. The predominant product of reduction of α -ketoester with sodium borohydride is
- Primary alcohol
 - Secondary alcohol
 - Alkane
 - Vinyl borane
17. Toluene on reaction with N-bromosuccinimide gives
- p-Bromomethyl benzene
 - o- Bromomethyl benzene
 - Phenyl bromomethane
 - m-Bromomethyl benzene
18. $CaCO_3(s) = CaO(s) + CO_2(g)$
The number of degrees of freedom for the above equilibrium reaction is
- 0
 - 1
 - 2
 - 3
19. A catalyst is one which speeds up the reaction by
- decreasing the enthalpy of the reactants
 - decreasing the free energy of the reaction
 - increasing the kinetic energy of the reactants.
 - decreasing the activation energy of the reaction.
20. In a chemical reaction, the fraction of the reactant consumed per unit time is independent of the initial concentration. The order of the reaction is
- indeterminate
 - two
 - one
 - zero
21. If q is the amount of heat supplied by the system and w is the magnitude of the work done on the system, the change in internal energy of the system equals
- $-q + w$
 - $a - w$
 - $q + w$
 - $q - w$
22. A drop of ink put in a glass of water mixes uniformly with the passage of time. This is due to
- gravitational force
 - minimization of potential energy
 - maximization of entropy
 - osmotic pressure of pure water.
23. A 0.2 M solution of sugar is isotonic with a solution of common salt. Both solutions have the same volume and are at the same temperature. The concentration of the common salt solution is
- 0.1 M
 - 0.2 M
 - 0.3 M
 - 0.4 M
24. The molar conductivity of a strong electrolyte varies
- linearly with concentration.
 - linearly with the square root of concentration.
 - inversely with concentration.
 - as the square of the concentration.

25. That the specific heat of a stable solid is positive, can be derived from
- Gibbs-Helmholtz equation.
 - Kirchoff's equation.
 - the first law of thermodynamics
 - the second law of thermodynamics
26. Explain the following observations
- $[\text{CoF}_6]^{3-}$ is paramagnetic while $[\text{Co}(\text{CN})_6]^{3-}$ is diamagnetic. (1)
 - AgNO_3 gives a white precipitate with aqueous solution of $\text{Na}_2\text{S}_2\text{O}_3$ which dissolves in excess of $\text{Na}_2\text{S}_2\text{O}_3$. If the precipitate is heated with water, it turns black and the supernatant liquid gives a white precipitate with acidified $\text{Ba}(\text{NO}_3)_2$. Write the balanced chemical equations involved. (4)
27. (i) Why is electron affinity of fluorine less than that of chlorine? (2)
- (ii) Why is ammonia more soluble in aqueous ammonium chloride than it is in pure water? (2)
- (iii) Why is cyclopentadiene an extraordinarily acidic hydrocarbon? (1)
28. (i) Bromoalkenes are usually converted to alkynes by treatment with KNH_2 but 1-bromocyclohexene does not undergo dehydrohalogenation under these conditions. Explain. (2)
- (ii) Write steps involved in the conversion of benzene to 2,6-dinitrochlorobenzene. (2)
- (iii) Draw a Fischer projection formula for the distereoisomer of 2R, 3R-2-chloro-3-bromobutane. (1)
29. (i) Diels Alder reaction between 2,5-dimethyl-1,3,4-diphenylfuran and dimethylfumarate does not take place. Explain why. (2)
- (ii) Calculate pH of the solution at equivalence point of a titration between 0.1 M acetic acid and 0.1 M sodium hydroxide solution. (Apparent dissociation constant of acetic acid at this ionic strength is equal to 2.7×10^{-5}). (2)
- (iii) Assuming that there is no change in pressure and temperature estimate the change in entropy when two cylinders containing equal volumes of ideal gas are interconnected. (1)
30. (i) Derive the thermodynamic equation of state, $(\partial U/\partial V)_T = T(\partial P/\partial T)_P - P$ (2)
- (ii) When the concentration of both Zn^{2+} and Cu^{2+} ions is 1.0 M, the emf of a Daniel cell is 1.10 V. Calculate the emf of the cell if the concentrations of Zn^{2+} ions and Cu^{2+} ions are changed to 2.0 M and 0.5 M respectively. (2)
- (iii) Why absolute alcohol cannot be prepared from aqueous alcohol by distillation? (1)

J : BIOCHEMISTRY

ONE MARKS QUESTIONS (1-25)

For each sub-question given below, four alternatives are provided of which only one is appropriate. Write the answer in the answer book by writing a, b, c or d along with the corresponding sub-question number.

(1 × 25 = 25)

1. The pH of 1 mM MCl is
- 1
 - 2

- c. 0
d. 3
2. The length of an a helical section of a polypeptide chain of 20 residues would be
a. 30 Å
b. 20 Å
c. 5.4 Å
d. 3.6 Å
3. Which one of these reagents is best suited for identification of the amino terminal residue of a peptide of which you have less than 0.1 µg.
a. performic acid
b. dansyl chloride
c. fluoro dinitrobenzene
d. cyanogen bromide
4. If a solution of double stranded DNA is heated above its melting temperature, its absorbance will,
a. decrease
b. increase
c. remain unchanged
d. initially increase and then decrease
5. β-amylase cleaves
a. α (1-4) glycosidic bonds
b. β (1-4) glycosidic bonds
c. α (1-6) glycosidic bonds
d. β (1-6) glycosidic bonds
6. Gangliosides contain
a. a ceramide structure
b. glucose or galactose
c. sialic acid
d. all of the above
7. A southern transfer of *E. coli* DNA after complete digestion with ECOR1 was probed with labeled cDNA probe of a gene which occurs only once in the *E. coli* genome. If the gene contains one ECOR1 cleavage site near its centre, the number of radioactive bands you are most likely to find on autoradiography would be
a. 0
b. 1
c. 2
d. 3
8. The largest energy reserve (kilocalories) in humans is
a. blood glucose
b. liver glycogen
c. muscle glycogen
d. adipose tissue triacylglycerol
9. Both strands of DNA serve as templates concurrently in
a. replication
b. mismatch repair
c. excision repair
d. all of the above
10. In which of the following does the inner surface of a closed membrane or vesicle become the outer surface of a closed membrane or vesicle
a. fusion of two intracellular vesicles
b. transfer of an endoplasmic reticular membrane into golgi membrane via vesicle
c. exocytosis of a secretory vesicle
d. division of a bacterial cell
11. Enzyme linked immunosorbent assay used to detect antigens or antibodies utilizes those enzymes that
a. have a high turnover rate
b. yield a stable colored product
c. are stable on conjugation to proteins
d. all of the above
12. Which of the following hormones uses cyclic AMP as the second messenger
a. follicle stimulating hormone
b. insulin
c. progesterone
d. gonadotropin releasing hormone
13. IgM class of antibodies are more effective than IgG in bringing about complement mediated lysis because
a. IgM has higher affinity for complement components
b. IgM has higher affinity for antigen binding
c. IgM is a pentamer
d. IgM is present in higher concentration
14. Which of the following statements is false
a. MHC class II molecules are present on all nucleated cells
b. MHC class II molecules are made up of two polypeptides

- c. MHC class I molecules are present on all nucleated cells
 d. T cell response is MHC - restricted
15. Which of these substrates is best suited for measuring RNA synthesis by RNA polymerase
 a. γP^{32} ATP
 b. αP^{32} d ATP
 c. γP^{32} d ATP
 d. αP^{32} UTP
16. The tripeptide sequence encoded by the following polydeoxyribonucleotide sequence, 5'CCC AAA TAC 3', would be
 a. pro lys tyr
 b. met phe gly
 c. met gly lys
 d. met phe lys
17. All of the following are true about transposons except
 a. transposons move from one location to a different one within a chromosome
 b. both donors and target sites must be homologous
 c. transposons may activate a gene
 d. transposons may inactivate a gene
18. The class of immunoglobulins that can get transported across epithelial cells is
 a. IgG
 b. IgE
 c. IgA
 d. IgM
19. A muscle extract is dialysed exhaustively against 10 mM sodium phosphate buffer, pH 7.0. The extract does not contain any ATPase activity. If ATP is now added, the following cofactor that also must be added to convert glucose to glucose-6- phosphate is
 a. NAD^+
 b. $FADH^2$
 c. Mg^{2+}
 d. Fe^{3+}
20. Injection of dinitrophenol (DNP) into a rat causes an immediate increase in its body temperature, because
 a. DNP acts as an inhibitor of mitochondrial ATPase
 b. DNP blocks the electron transport chain
 c. DNP inhibits succinic dehydrogenase
 d. DNP uncouples electron transport from oxidative phosphorylation
21. A rat liver extract is treated with avidin. Which of the following conversion in gluconeogenesis will not occur
 a. glyceraldehyde 3-P \rightarrow glucose 6 P
 b. malate \rightarrow oxaloacetate
 c. pyruvate \rightarrow phosphoenolpyruvate
 d. fumarate \rightarrow phosphoenolpyruvate
22. The direct effect of cyclic AMP in the protein Kinase A pathway is to
 a. activate adenylate cyclase
 b. dissociate regulatory subunits from protein Kinase A
 c. phosphorylate protein Kinase A
 d. release hormones from target tissue
23. The active site amino acid residue that could be involved in a reaction catalyzed by an enzyme with a pH optimum of 4 would be
 a. arginine
 b. cysteine
 c. serine
 d. glutamate
24. The isoelectric pH of γ globulin, human serum albumin (HSA) ribonuclease (RNAase) and hen egg lysozyme (HEL) are 6.6, 4.9, 7.8 and 11.0 respectively. The order in which these proteins will be eluted from a CM cellulose ion exchange column by an increasing salt gradient at pH 7.0 would be
 a. HSA, γ globulin, RNAase and HEL
 b. HEL, RNAase, γ globulin, HSA
 c. HEL, γ globulin, RNAase, HSA
 d. HSA RNAase, HEL, γ globulin
25. A solution contains DNA polymerase I, Mg^{2+} salts and dNTPs. Which of these molecules would act as template and lead to DNA synthesis
 a. single stranded RNA base paired with a primer with a free 3' OH group
 b. single stranded DNA base paired with a primer with a free 5' OH group

- c. single stranded DNA base paired with a primer with a free 3' OH group
 d. double stranded DNA base paired with a free 3' OH group at each end
26. Give correct answers to the following -
 (1 = 5 = 5)
- a. Which of the following amino acids are likely to have their side chains on the inside of globular proteins in solution.
 val, pro, phe, asp, lys, ile, his
- b. Which of the following ion exchangers would be suitable for purification of a DNA binding protein and why?
 (i) CM cellulose
 (ii) DEAE cellulose
- c. What is the coenzyme form of vitamin B6? Name the reactions in which this coenzyme is involved.
- d. In a preparation of mitochondria, oxidation of fatty acids is carried out in presence of CoA, O₂, ADP and P_i.
 (i) How many molecules of ATP will be produced per two carbon fragments converted to CO₂?
 (ii) What will this number be if amytal is added to the preparation?
- e. Northern analysis of nuclear RNA and cytoplasmic RNA from liver when probed with aldolase genomic clone showed that the nuclear RNA specific to aldolase had a molecular weight higher than that of cytoplasmic RNA. Explain why?
27. Answer the following in one sentence each (Do not exceed)
 (1 = 5 = 5)
- a. What are RAG genes?
 b. What are recombination signal sequences?
 c. How does simultaneous expression of IgM and IgD occur in mature B cells?
 d. Name any four members of the immunoglobulin super family other than immunoglobulin?
 e. Define monoclonal antibodies.
28. State true or false against each of the following -
 (1 = 5 = 5)
- a. Methylation of lysine α -amino group occurs in histones to modulate their interaction with DNA
 b. In all cases of diabetes mellitus, circulatory levels of insulin are low or negligible.
 c. While bone marrow is the primary lymphoid organ, thymus and spleen are secondary lymphoid organs.
 d. Both in the liver and muscle, glycogen functions as a glucose reserve for maintenance of blood glucose concentration.
 e. Type I topoisomerases create transient single stranded breaks in DNA, whereas type II topoisomerases make transient double stranded breaks in DNA
29. Match the entries in column 1 with the appropriate one in the column 2 and write matching pairs in the answer book
- A. ionophore
 B. ouhain
 C. malonate
 D. alkaptonuria
 E. protein hydrolyzing enzymes
1. cathepsin
 2. Na⁺K⁺-ATPase
 3. Homogentisic acid oxidase
 4. phenylalanine hydroxylase
 5. penicillin
 6. gramicidine A
 7. competitive inhibitor of succinic dehydrogenase
30. (a) The K_m of a certain enzyme is 1 μ M. At a substrate concentration of 1mM, the V_{max} is 50 μ moles/min. However the V_{max} remained the same, even at a ten fold lower concentration of the substrate. Explain.
 (2)
- (b) Restriction analysis of a fragment of dsDNA with Hind III gave fragments of sizes 2.8 kb and 1.2 kb. The same DNA upon digestion with BamHI, yielded fragment sizes of 1.8 kb, 1.3 kb and 0.9 kb. Double digestion of the DNA with both these enzymes yielded

fragment sizes 1.8 kb, 1.0 kb 0.9 kb and 0.3 kb. Making use of this data draw a restriction map of the DNA fragment.

- (c) Define isoenzymes. (2)

(1)

K: BIOTECHNOLOGY

ONE MARKS QUESTIONS (1-25)

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(25 × 1 = 25)

- The limiting factor in the production of large quantities of ethanol as bio-fuel is
 - Lack of a balanced medium
 - Ethanol toxicity to cells
 - Expensive downstream processing steps
 - Only (b) and (c) of the above
- Gel retardation assay is routinely used to monitor interactions between
 - Proteins
 - Drug and nucleic acid
 - Nucleic acids
 - Protein and nucleic acid
- Efficient expression of a heterologous protein product is influenced by
 - Transcriptional efficiency
 - Copy number of the plasmid
 - Codon bias
 - All of the above
- The fundamental feature of the genetic code which allows the expression of a protein in any host is its
 - Triplet nature
 - Universality
 - Degeneracy
 - Redundancy
- When thymidine synthesis is inhibited, eukaryotic cells will be arrested at
 - End of S phase
 - End of M phase
 - G1/S interphase
 - G2/M interphase
- To PCR amplify the sequence
 ATCTTCTACGAAGCPTGCGG
 TAGAAGATGC..... TTCGAACGCC
 The required primers are
 - ATCTTCTA and CGAACGCC
 - ATCTTCTA and CCGCAAGC
 - TAGAAGAT and CGAACGCC
 - TAGAAGAT and CCGCAAGC
- The major groove of DNA is lined by
 - N3 of purine and N1 of pyrimidine
 - N7 of purine and O2 of pyrimidine
 - N7 of purine and C4 of pyrimidine
 - None of the above
- The heterozygosity of any locus can be ascertained by
 - RFLP analysis
 - SNPs
 - FISH analysis
 - Either RFLP analysis or SNPs
- BAC, which can be used to clone large DNA fragments, is derived from
 - ColE plasmid
 - F plasmid
 - 2 μ
 - Mu phage
- Antibody diversity is generated by
 - Protein splicing
 - Somatic mutation
 - Allelic exclusion
 - Inter-chromosomal recombination
- Resistance to herbicide chlorsulfuron in plants is due to a change in
 - Glutamine synthetase
 - Acetolactate synthase
 - Threonine deaminase
 - DNA polymerase
- A heterologous protein for its expression in the milk of a transgenic animal should be under the control of the promoter of the gene coding for
 - β -Globin
 - β -Lactoglobulin

- c. Preproinsulin
d. lacZ
13. To isolate a gene coding for glucagon, the cDNA library has to be constructed using mRNA isolated from
- Intestine
 - Pancreas
 - Pituitary
 - Brain
14. If the fractional recovery at each step of unit operation is 0.8, the recovery after 4 steps will be
- 0.24
 - 3.23
 - 0.41
 - 0.82
15. The factor(s) likely to increase the rate of reaction catalyzed by a surface immobilized enzyme is/are
- Increased agitation of the bulk liquid containing the substrate
 - Continued replacement of the bulk liquid containing the substrate
 - Increased concentration of the substrate in the bulk liquid
 - All of the above
16. Which of the following cases are likely to lead to faster rates of catalysis by an enzyme immobilized on a negatively charged support?
- A positively charged substrate and a negatively charged product
 - A negatively charged substrate and a positively charged product
 - A positively charged substrate and a positively charged product
 - None of the above
17. The essential component of Tj plasmid required for integration into plant genome is
- Origin of replication
 - Tumor inducing gene
 - Nopaline utilization gene
 - All of the above
18. Positional cloning approach exploits information
- On the location of the gene in the genome
 - On the status of its expression
 - About the position of promoter relative to MCS
 - About the position of the restriction sites
19. Hormone pairs required for a callus to differentiate are
- Auxin and cytokinin
 - Auxin and gibberellin
 - Ethylene and gibberellin
 - Cytokinin and gibberellin
20. Reverse genetics means
- Finding the function of a ORE
 - Finding the gene responsible for a trait
 - RNA dependent DNA synthesis
 - Convening somatic cell to a germ cell
21. Which of the following statements applies to the operation of a fed-batch process?
- The volume of the culture increases with time
 - it helps controlling repressive effects of the nutrient being fed
 - It eliminates the need for oxygen supply
 - Only (a) and (b) of the above
22. A gene can not be isolated from a human genomic DNA library by functional complementation in E. coli because of
- Non-functional promoter
 - The absence of splicing machinery
 - Coupled transcription and translation
 - Codon bias
23. in large-scale fermentation, the preferred method of sterilization is
- Chemicals
 - Radiation
 - Filtration
 - Heat
24. Embryo rescue is a useful technique to
- Grow/generate hybrids between different plant species
 - Complete the growth of embryos susceptible to defects in seed development
 - Break the dormancy of seeds
 - All of the above

25. Which of the following is not true of aerobic digestion?
- It generates most sludge
 - It generally incurs higher running cost
 - It may generate a usable fuel
 - Requires a shorter residence time
26. Match the products in Column A with their corresponding organisms in Column B (5)

Column A

- Aspergillus niger*
- Saccharomyces cerevisiae*
- Penicillium chrysogenum*
- Lactobacillus casei*
- Corynebacterium glutamicum*

Column B

- Lysine
- Citric acid
- Acetone/ butanol
- Vitamin B₁₂
- Erythromycin
- β -Lactam
- Diacetyl
- Ethanol

27. Match the unit operations in Column A with the most appropriate recovery stage in Column B (5)

Column A

- Drying
- Sedimentation
- Membranes
- Cell disruption
- Chromatography

Column B

- Pretreatment
- Purification
- Formulation
- Solid/liquid separation
- Solid/solid separation
- Concentration

28. (a) A chemostat is operating at steady state at a dilution rate of 0.1 hr^{-1} and a limiting nutrient concentration of $10 \mu\text{M}$. If the μ_{max} for the organism

is 0.5 hr^{-1} calculate the Monod constant for the nutrient.

(3)

- (b) Why asparaginase is used in anticancer therapy?

(2)

29. (a) Write the reaction catalyzed by penicillin G acylase.

(1)

- (b) Name any two techniques by which penicillin G acylase may be immobilized.

(2)

- (c) Why are mammalian cells cultured in CO₂ incubators?

(1)

- (d) Mention an important post translational modification absent in prokaryotes making them unsuitable hosts for expressing human genes.

(1)

30. (a) The sequences at the cloning site of three vectors are given below. The BamHI (GGATCC) and HindIII (AAGCTT) sites are underlined. Only the sequences around the restriction sites are shown. The symbol "_____" indicates rest of the sequence.

Vector 1: _____ ATGCGTCGGATCCGGC _____ AAGCTT _____

Vector 2: _____ ATGCGTCGGATCCGGC _____ AAGCTT _____

Vector 3: _____ ATGCGTCGGATCCGGC _____ AAGCTT _____

Which one of the above three vectors is appropriate to clone the following ORF

_____ ATGCCAACACCCGGATCCCG _____
TAAAAGCTT _____

for expression? Give the reason in one sentence.

(2)

- (b) Draw the restriction map of the plasmid given the following data (the gel pattern shown below is not to scale). The size of each DNA fragment (in kb) is indicated next to it.

(3)

Q.No	Ans	Q.No	Q.No	Q.No	Q.No
34	54				
		21	21		34
		19		19	18
		14	14	14	
			13	12	
		04		09	

L : BOTANY

ONE MARKS QUESTIONS (1-25)

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(25×1 = 25)

- Which of the following proteins is a major component of cytoskeleton?
 - Tubulin
 - Fibrin
 - Osmotin
 - Porin
- The specialized tissue in the roots of epiphytic orchids is known as
 - Haustoria
 - Laticifer
 - Velamen
 - Periderm
- Lenticel originates from
 - Guard cells
 - Subsidiary cells
 - Complimentary cells
 - Companion cells
- Plant cell suspension culture is easily initiated from
 - Shoot apex
 - Root apex
 - Protoplast
 - Friable callus
- The process by which the pollen tube enters the ovule through micropyle is
 - Chalazogamy
 - Basigamy
 - Porogamy
 - Mesogamy
- Germplasm preservation through tissue culture is
 - In situ conservation
 - Ex situ conservation
 - Protected area conservation -
 - Both in situ and a situ conservation
- The taxa in danger of extinction is termed
 - Extinct
 - Rare
 - Vulnerable
 - Endangered
- 1.8 The best definition of biodiversity is variability
 - Within species only
 - Between species only
 - Both within and between species
 - Within species, between species and of ecosystem
- The diploid number of an organism is 12. How many chromosomes would be expected in its nullisomic?
 - 10
 - 11
 - 13
 - 14
- The vascular bundle having xylem and phloem strands in alternate radii is known as
 - Collateral
 - Bicollateral
 - Radial
 - Concentric
- The average number of chiasma in one pair of homologous chromosome is 1.4. The total length (in map units) for the linkage group is expected to be
 - 90
 - 70
 - 50
 - 30
- A functional unit of gene which specifies one polypeptide is known as
 - Codon
 - Muton
 - Cistron

- d. Recon
13. How many base pairs are present per complete nucleosome?
 a. 166
 b. 156
 c. 146
 d. 136
14. Which of the following plants is a member of evergreen coniferous forest?
 a. Acacia
 b. Shorea
 c. Cryptomeria
 d. Rhizophora
15. Choose the correct statement about phylogenetic system of classification
 a. Proposed by John Hutchinson
 b. Evolutionary sequence is not considered
 c. One or a few superficial character(s) is/are considered
 d. Proposed by Linnaeus
16. Koch's postulates pertain to
 a. Disease and causal organism
 b. Bacterial metabolism
 c. Viral replication
 d. Fungal disease resistance
17. Aflatoxins are toxic chemicals produced by
 a. *Aspergillus flavus*
 b. *Alternaria alternata*
 c. *Fusarium oxysporum*
 d. *Clostridium tetani*
18. Late blight of potato is caused by
 a. Potato virus Y
 b. *Alternaria solani*
 c. *Phytophthora infestans*
 d. *Phytophthora megasperma*
19. Which one of the following is an essential ingredient in Bordeaux mixture?
 a. Mercuric chloride
 b. Arsenic oxide
 c. Lead nitrate
 d. Copper sulfate
20. The most widely used chemical for protoplast fusion, as fusogen, is
 a. Mannitol
 b. Polyethylene glycol
 c. Sorbitol
 d. Glycerol
21. How many molecules of ATPs are produced during oxidation of each molecule of NADH?
 a. 1
 b. 2
 c. 3
 d. 4
22. Photo system II has an absorption maximum at
 a. 450 nm
 b. 660 nm
 c. 680 nm
 d. 700 nm
23. CO₂ fixation during C₄ pathway occurs in the chloroplast of
 a. Bundle sheath cell
 b. Palisade parenchyma
 c. Spongy parenchyma
 d. Guard cell
24. The growth retardant cycocel (CCC) inhibit sub-apical cell division by blocking the biosynthesis of
 a. Abscisic acid
 b. Kinetin
 c. Traumatic acid
 d. Gibberellin
25. Pollination effected by wind is called
 a. Ornithophily
 b. Anemophily
 c. Entomophily
 d. Hydrophily
26. Write botanical name of the most common plant yielding the following products
 A. Ephedrine
 B. Caffeine
 C. Azadirachtin
 D. Atropine
 E. Theophylling
27. (a) List three major advantages of micro propagation.

(5 × 1 = 5)

(3)

- (b) Define cybrid and state its application in crop breeding. (2)
28. (a) Outline the reaction sequences in nitrate reduction, indicating name of the enzymes and their locations in the leaf cell. (2)
- (b) C_4 plants have been reported to use nitrate more efficiently than C_3 plants. Explain the reason. (2)
29. (a) Give a simplified diagram for a composite transposon. (2)
- (b) Mention three applications of transposons. (3)
30. (a) Depict the structure of a wild type Ti-plasmid. Label the diagram. (3)
- (b) Describe the basic principle of micro projectile bombardment mediated DNA delivery. (2)
- d. Mycoplasma
3. Archaeal cells usually do not contain peptidoglycan, rather contain pseudo-peptidoglycan which is mainly composed of
- N-acetylmuramic acid and L-amino acids
 - N-acetylglucosaminuronic acid and D-amino acids
 - N-acetylmuramic acid and D-amino acids
 - N-acetylglucosaminuronic acid and L-amino acids
4. Some bacteria contain extensive internal membranes that are involved with specific functions. One example of such membranes is chromatophores, which are
- Photosynthetic membranes where light is converted to chemical energy in the form of ATP
 - Convolutions of the inner membrane that extend into the interior of the mitochondrion
 - Internal membranes where inorganic nitrogen containing compounds oxidize to generate ATP
 - Interior compartment of chloroplast where fixation of CO_2 occurs.
5. In establishing proton gradient for chemiosmotic ATP generation by 'aerobic respiration' the terminal electron acceptor is
- Nitrate
 - Oxygen
 - Sulfate
 - CO_2
6. In which of the following splicing events, the intermediates do not form the lariat or the branched structure?
- Trans splicing
 - Group I intron splicing
 - Group II intron splicing
 - hnRNA splicing
7. Which of the following statements is incorrect for the life cycle of bacteriophage MS2?
- The phage RNA is (+) stranded and it can act as mRNA

M: MICROBIOLOGY

ONE MARKS QUESTIONS (1-25)

For each question given below there are four alternatives, of which only one is the correct answer. Write the correct answer in the answer book by writing a, b, c or d along with the corresponding sub-question number.

(1 × 25 = 25)

1. Which of the following organelles contains DNA, divides and possesses some degree of autonomy?
- Golgi apparatus
 - Ribosome
 - Chloroplast
 - Peroxisomes
2. Which of the following microorganisms is classified as a member of archaeobacteria
- Cyanobacterium
 - Methanobacteria
 - Trichomonads

- b. Negative strand RNA is synthesized by the phage encoded RNA replicase
- c. Ribosomal frame shifting occurs to control the expression of lysis gene
- d. MS2 encoded repressor protein allows this virus to undergo lysis
8. Which of the following sets of surface associated micro-organisms are populated in the upper respiratory tract (nasal cavity and nasopharynx)?
- Lactobacillus, Escherichia, Enterobacter
 - Streptococcus, Staphylococcus, Neisseria
 - Streptococcus, Lactobacillus, Candida
 - Klebsiella, Staphylococcus, Enterobacter
9. Autoimmune diseases result from failure of the immune system to recognize self antigen as self. Following are the sets of autoimmune diseases with the corresponding antigens, which one is the incorrect one.
- Myasthenia gravis - platelets
 - Rheumatoid arthritis - collagen
 - Systemic lupus erythematosus - La nucleo-protein
 - Hashimoto thyroiditis - Thyroglobulin
10. The basis for tuberculin test used to detect Mycobacterium tuberculosis infection is
- Anaphylactic hypersensitivity (Type 1)
 - Antibody dependent cytotoxic hypersensitivity (Type 2)
 - Immune complex mediated hypersensitivity (Type 3)
 - Cell mediated delayed hypersensitivity (Type 4)
11. One of the post replication modifications in DNA is the methylation of the bases. In this context which of the following statements is incorrect.
- Methylation protects cell's own DNA from digestion by its own restriction endonuclease(s)
 - Methylation may result in the localized conversion of B-DNA to Z-DNA
 - Methyl groups are added predominantly to cytosines in bacterial cells and to adenines in eukaryotes
 - Methylation of bases is important in some aspects of DNA repair in bacteria
12. Where in the cells of the eukaryotic organisms are the ribosomes assembled?
- Nucleolus
 - Cytoplasm
 - Lysosomes
 - Golgi bodies
13. In a mitotically dividing cell, G₂ phase occurs at the
- Beginning of interphase
 - Towards the end of interphase
 - Just before the DNA synthesis
 - Interphase of a mitotically dividing cells is too short to be sub-divided
14. Malt used to ferment beer is prepared by
- Roasting barley
 - Washing the barley with water and drying it in air
 - Barley is soaked in water, germinated and dried
 - Barley is treated with bovine amylase and roasted
15. Which of the following equations is correct for double stranded DNA
- $A + T = G + C$
 - $\frac{G}{A} = \frac{T}{C}$
 - $A + C = G + T$
 - $\frac{A}{G} = \frac{C}{T}$
16. There are five classes of the antibodies (IgM, IgD, IgG, IgE, IgA). What determines the class to which an antibody belongs?
- Structure of the light chain
 - Variable region of the antibody
 - Structure of the heavy chain constant region
 - Stage of the infection
17. Antigen binding sites of an immunoglobulin are located in
- Light chain alone
 - Heavy chain alone
 - F_c region of the antibody
 - F_{ab} regions of the antibody
18. Pasteurization of milk is done by

- a. Boiling the milk for 20 minutes
 b. Heating the milk at 72°C for 30 minutes
 c. Heating the milk at 72°C for 20 minutes
 d. Heating the milk at 62°C for 30 minutes
19. The resolving limit of a microscope is defined by which of the following equation. In the equation, 'd' defines the resolving limit, 'λ' is the wavelength of the light source, 'N' is the refractive index of the medium between the lens and object, 'α' is the half angle of the objective lens
- a. $d = \frac{\lambda}{N \cdot \alpha}$
 b. $d = \frac{\lambda}{N \cdot \sin \alpha}$
 c. $d = \frac{0.5\lambda}{N \cdot \sin \alpha}$
 d. $d = \frac{0.5N}{\lambda \cdot \sin \alpha}$
20. Mode of action of rifampicin in *E. coli* is through inhibiting
- a. Cell division
 b. Initiation of transcription
 c. RNA polymerase binding to DNA template
 d. Inhibition of the oxidation potential
21. The DNA polymerase responsible for semi conservative replication in *E. coli* is
- a. DNA polymerase I
 b. DNA polymerase II
 c. DNA polymerase III
 d. DNA polymerase IV and V
22. Subunit composition of *E. coli* RNA polymerase holoenzyme is
- a. $\alpha\alpha'\beta\beta'\sigma$
 b. $\alpha\beta\beta'\sigma$
 c. $\alpha\alpha'\beta\sigma$
 d. $\alpha\beta\sigma$
23. During protein synthesis in *E. coli*, aminoacyl tRNAs are bound to the A site. Following transpeptidation reaction the peptidyl-tRNA is moved to the ribosomal P site, Factor involved at the translocation step is
- a. EF-Ts
 b. EF-Tu
 c. EF-G
 d. EF-1α
24. Shine-Dalgarno sequence found in the prokaryotic mRNAs facilitates ribosome binding by its interaction with the 3' end of the
- a. 5S rRNA
 b. 23S rRNA
 c. 16S rRNA
 d. 18S rRNA
25. Diphtheria toxin
- a. Acts catalytically
 b. Releases incomplete polypeptide chains from ribosomes
 c. Leads to misreading of mRNA
 d. Cleaves 16S rRNA into two fragments
26. Answer the following:
- a. How are the P1 and λ phages different with respect to their transduction properties? (1)
- b. Which one of the two phages (P1 and λ) will be useful to transduce a marker linked to Tn 10 in an unknown location on the B coil chromosome? (1)
- c. An F⁻ strain of *E. coli* gave rise to Hfr progeny by random integration of the F factor into the circular chromosome at many points such that the segregants transfer the genetic markers in different order. When six of the Hfr segregants were checked for the order of the marker transfer to a recipient by interrupted mating experiments, following results were obtained. What is the order of the markers (3)

Hfr segregant	Order of marker transfer into an appropriate recipient
1	— PAQB —→
2	— CZEF —→
3	— EFBO —→
4	— FEZC —→
5	— ZCWD —→
6	— AFDW —→

27. Extensive nuclease digestion of chromatin results in a 146 bp 'nucleosome core'

particle. This core particle is inked with another unit through a linker of varying length. A eukaryotic organism contains a single chromosome of 2×10^8 bp. Given that the Avogadro's number is 6.02×10^{23} , answer the following.

(1 = 5 = 5)

- What is the number of nucleosomes in this organism if the average linker length was 54 bp?
- Name the core histones.
- What is the number of core histone molecules present on the chromosome?
- If the volume of nucleus is considered to be $0.001 \mu\text{L}$, what is the concentration of each of the core histones.
- Which of the histones is not present on the nucleosome core particle?

28. Organisms can utilize α -ketoglutarate glutamate and aspartate to fix NH_3 .

- What are the enzymes that utilize α -ketoglutarate, glutamate and aspartate to fix NH_3 ?

(3)

- What cofactor (s) are used to fix NH_3 utilizing α -ketoglutarate?

(1)

- How many molecules of NH_3 can be fixed during conversion of α -ketoglutarate to glutamine?

(1)

29. If Down syndrome occurs in 1 out of 700 births and the Turner syndrome occurs in 1 out of 5000 cases, what are the chances that the following will occur?

- Two cases of Down syndrome in one hospital on the same day.

(2)

- If the number of births in a country is 35×10^6 , how many cases of Down syndrome are likely to be recorded among the new borns?

(1)

- If the Down and Turner syndromes are randomly distributed, what are the chances that a new born will be found with the Down syndrome and Turner syndrome.

(2)

30. The following are the examples of host cell surface receptor proteins that facilitate virus entry into the host cell. Match the names of the viruses (panel A) with the names of the corresponding receptors used (panel B).

(1 = 5 = 5)

Virus

- Vaccinia virus
- Rhinovirus
- Epstein-Barr virus
- Herpes Simplex virus type I
- Human immunodeficiency virus

Cell surface Protein

- Intracellular adhesion molecules on the surface of respiratory epithelial cells (ICAM)
- Receptor for C_3d complement protein on human B lymphocyte
- CD4 protein on T-helper cells
- Epidermal growth factor receptor
- Fibroblast growth factor receptor

N: ZOOLOGY

ONE MARKS QUESTIONS (1-20)

For each sub-question given below, four alternatives are provided of which only one answer is correct. Write the correct answer in the answer book by writing a, b, c or d along with the corresponding sub-question number.

(1 × 20 = 20)

- The line that divided oriental zoogeographic region from that of Australian zoogeographic region is known as
 - Wallace line
 - Darwin line
 - Lyel line
 - Smith line
- The nematodes are
 - Acoelomate organism
 - Pseudocoelomate organism
 - Coelomate organism
 - Hemocoelomate organism

3. The origin of vertebrate during evolution occurred during
 - a. Cenozoic era
 - b. Mesozoic era
 - c. Paleozoic era
 - d. Archeozoic era
4. Dinosaurs first appeared and adaptive radiation of reptiles took place during
 - a. Cretaceous period
 - b. Jurassic period
 - c. Triassic period
 - d. Carboniferous period
5. The giant panda is a natural inhabitant of
 - a. India
 - b. China
 - c. Australia
 - d. North America
6. Anuran heart is divided into
 - a. One chamber
 - b. Two chambers
 - c. Three chambers
 - d. Four chambers
7. The antibody whose concentration is highest in human blood under normal condition is
 - a. IgM
 - b. IgA
 - c. IgE
 - d. IgG
8. The prosthetic group in respiratory pigment hemocyanin is
 - a. Iron
 - b. Copper
 - c. Mercury
 - d. Zinc
9. The phenomenon of MHC restriction was discovered by
 - a. Doherty and Zinkernagel
 - b. Medawar and Billingham
 - c. Edelman and Porter
 - d. Burnet and Nossal
10. Working principle behind DNA vaccine is believed to be
 - a. Anti DNA antibody is produced in vaccinated individual
 - b. The vaccine DNA codes for antibody directed against the pathogen
 - c. The vaccine DNA codes for antigenic protein which is expressed in the immunized animal
 - d. The vaccine DNA boosts the immune system of the animal
11. The RNA molecule often used to determine evolutionary relatedness is
 - a. Messenger RNA
 - b. Transfer RNA
 - c. Ribosomal RNA
 - d. Sn RNA
12. A post-pubertal human female would have more number of ova at the age
 - a. 45
 - b. 35
 - c. 25
 - d. 15
13. The precursor for coenzyme A is
 - a. Niacin
 - b. Thiamine
 - c. Riboflavin
 - d. Pantothenic acid
14. A major protein constituent of plasma membrane of erythrocytes is
 - a. Haemoglobin
 - b. Glycophorin A
 - c. Albumin
 - d. Actin
15. The codon for amino acid tryptophan is
 - a. UAA
 - b. UAG
 - c. UGA
 - d. UGG
16. Beriberi is the result of deficiency of
 - a. Vitamin B1
 - b. Vitamin B2
 - c. Vitamin B6
 - d. Vitamin B12
17. The genes for T cell receptors were characterized by
 - a. Tonegawa
 - b. Kabat
 - c. Benaceraf
 - d. Jerne

18. The hormone secreted by adrenal cortex is
 a. Adrenaline
 b. Corticosterone
 c. Prolactin
 d. Vassopressin
19. The histone octamer associated with nucleosome contains
 a. (H2A)₄ (H2B)₄
 b. (H3)₄ (H4)₄
 c. (H2A)₃ (H2B)₃ (H3)₃ (H4)₃
 d. (H2A)₂ (H2B)₂ (H3)₂ (H4)₂
20. Which of the following is called 'master gland of the endocrine orchestra'
 a. Pituitary
 b. Thyroid
 c. Thymus
 d. Adrenal gland
21. (a) Match the diseases in column A with their causative organism in column B.
 (1 = 3 = 3)
 (i) Malaria
 (ii) Filaria
 (iii) Sleeping sickness
 (a) Trypanosoma
 (b) Plasmodium
 (c) Wuchereria
 (d) Ascaris
- (b) Match the class of animals listed in column A with the phyla in column B.
 (1 = 2 = 2)
 (i) Arachnida
 (ii) Gastropoda
 (a) Mollusca
 (b) Arthropoda
 (c) Annelida
22. Define the following:
 (1 = 5 = 5)
 a. Telomere
 b. Osmoregulation
 c. Climax community
 d. Imprinting
 e. Aneuploidy
23. (a) To which class and order the following animals belong:
 (1 × 3 = 3)
 (i) mouse
 (ii) whale
 (iii) platypus
- (b) Why is the basal metabolic rate higher in rodents compared to elephants?
 (2)
24. (a) What are the conditions under which the frequency of dominant and recessive alleles in a population remains constant from generation to generation?
 (3)
 (b) What are molecular chaperons?
 (2)
25. (a) What is the function of homeotic genes in drosophila? What is the result of mutation in this gene?
 (2)
 (b) What is the function of the protein P53? What is the consequence of mutation in P53?
 (2)
 (c) What is the function of "checkpoints" in cell cycle?
 (1)
26. (a) Where is Gahir matha beach located? What zoological phenomenon it is associated with?
 (2)
 (b) What do you understand by the term "replicon"?
 (1)
 (c) What is codon degeneracy?
 (1)
 (d) Why lymphocytes are not suitable for animal cloning?
 (1)