LIFE SCIENCES

H : CHEMISTRY (COMPULSORY)

Useful Information:

Gas constant, $R = 8.314\ J\ mol^{-1}\ K^{-1}$

Planck's constant, $h = 6.626 \times 10^{-34}\ J\ s$

Mass of electron, $m_e = 9.108 \times 10^{-31}\ kg$

For each sub-question or statement given below, four alternatives are given 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 or statement number. (15 x 1 = 15)

1. Which one of the following elements has the largest atomic radius?
   a. Be
   b. C
   c. N
   d. F

2. The valence-electronic configuration of Cr atom (Atomic Number 24) in its ground state is
   a. $4s^1 3d^5$
   b. $3d^5 4s^1$
   c. $4s^2 3d^4$
   d. $3d^4 4s^2$

3. The phosphorus atom in the molecule PF_3 is in the state of hybridization
   a. sp^2
   b. sp^3
   c. p^3
   d. dsp

4. The ionic compounds MgO and CaO have the same crystal structure except that the interionic distances are 2.10 °A and 2.40 °A respectively. The ratio of the lattice energies, $U(MgO)/U(CaO)$, is
   a. 0.766
   b. 0.875
   d. 1.306

5. The quantities K_c and K_p are the concentration equilibrium constant and the pressure equilibrium constant for a reaction in gas phase. Which of the following relationships holds good if there is no change in the number of moles due to the reaction?
   a. $K_p = K_c$
   b. $K_p > K_c$
   c. $K_p < K_c$
   d. $K_p = \frac{1}{2} K_c$

6. Let p_1 and p_2 be the vapour pressure of water at 372 K and 374 K respectively. Then
   a. $p_1 > p_2$
   b. $p_1 = p_2$
   c. $p_1 < p_2$
   d. $p_1 = 2p_2$

7. Which one of the following alcohols will react most easily with HBr to give the corresponding bromide?
   a. CH_3OH
   b. $(CH_3)_3COH$
   c. CH_3CH_2OH
   d. $(CH_3)_2CHOH$

8. During the nitration of benzene with concentrated $HNO_3 - H_2SO_4$, the nitrating species is
   a. HNO_2
   b. NO_2
   c. NO_2^+
   d. NO_3^-

9. Which one of the following species is not isoelectronic with N_2?
   a. CN^-
   b. NO
   c. CO
   d. CS

10. One of the given elements combines with hydrogen to yield an electron-deficient

a. Be
b. C
c. N
d. O

11. The oxidation state of Ba in BaO_2 is
a. zero
b. +1
c. +2
d. +4

12. One of the species given below is a Lewis acid. Which one is it?
a. I
b. I^-
c. I_3^-
d. I_2

13. Identify the most stable species from the following divalent halides:
a. CCl_2
b. $GeCl_2$
c. $SnCl_2$
d. $PbCl_2$

14. Which of the following ligands causes the maximum crystal field splitting while forming a complex with Fe^{2+} ion?
a. H_2O
b. NH_3
c. CN^-
d. Cl^-

15. The formal oxidation state of Ni in $Ni(CO)_4$ is
a. zero
b. +1
c. +2
d. +4

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

(10 x 1 = 10)

16. The largest ionization energy is found with
a. alkali metals
b. alkaline earth metals
d. inert gases

17. In Planck's hypothesis E = energy of
a. a photon
b. a hydrogen atom
c. one electron
d. one H_2 molecule

18. The most widely applicable condition for spontaneity of processes is
a. $(\Delta E)_{S,V} \leq 0$
b. $(\Delta S)_{E,V} \geq 0$
c. $(\Delta A)_{T,V} \leq 0$
d. $(\Delta G)_{T,P} \leq 0$

19. The unit of the rate constant for a second-order process is
a. mol l^{-1} s^{-1}
b. s^{-1}
c. 1 mol s^{-1}
d. mol l^{-1}

20. The major product obtained for the reaction 2-methyl-2-butene with 50% H_2SO_4 in water is
a. 2-methyl-2-butanol
b. 3-methyl-2-butanol
c. 3-methyl-1-butanol
d. 2-methyl-1-butanol

21. The correct decreasing order of nucleophilic character of the following species is
a. $H_2O > Cl^- > NH_3 > OH^-$
b. $NH_3 > H_2O > Cl^- > OH^-$
c. $OH^- > Cl^- > NH_3 > H_2O$
d. $Cl > OH^- > H_2O > NH_3$

22. Which of the following species is aromatic?
a.

b.

c.


23. The reaction of 1-octyne with $HgSO_4$-$H_2SO_4.H_2O$ will give
   a. octan-1-one
   b. octan-2-one
   c. octan-3-one
   d. oct-1-ene

24. The correct order of decreasing rate of dehydrohalogenation of alkyl halides is
   a. RBr > RI > RCl > RF
   b. RI > RBr > RCl > RF
   c. RI > RBr > RF > RCl
   d. RI > RF > RBr > RCl

25. The reaction of sodium-phenoxide with CO_2 at high temperature and pressure fallowed by acidification gives
   a. p-hydroxy benzoic acid
   b. m-hydroxy benzoic acid
   c. o-hydroxy benzoic acid
   d. p-hydroxy sodium benzoate

26. Answer the following :
   1. Calculate the lattice energy of sodium chloride from the following data:

   ΔH_{vap} of Na(s) = 101 kJ/M

   $\Delta H_{dissociation}$ of $Cl_2(g)$ = 239 kJ/M

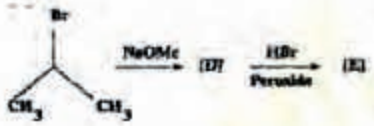
   ΔH_f of NaCl(s) = −411 kJ/M

   Ionization energy of Na(g) = 494 kJ/M
   Electron affinity of Cl(g) = 369 kJ/M (3)
   2. Find the speed of an electron that has a deBroglie wavelength of 1 nm. (2)

27. Answer the following :
   1. The reaction $CCl_3COOH \rightarrow CHCl_3 + CO_2$ is first-order with rate constant k = 6.7×10^{-7} s^{-1} at 25°C. The activation energy is 118 kJ/mol. Calculate k at 50°C. (3)
   2. Write the electronic configuration of N_2^+, and find the N-N bond order in the same species. (2)

28. Write the structures of compounds [A] – [E] formed in the following sequences of reactions:
   1.

   2.

   (2)

29. Answer the following :
   1. Draw the most stable conformation of each of the following compounds:
   a. cis-1,2-dibromocyclohexane,
   b. trans-4-t-butylcyclohexanol. (2)
   2. Nickel is estimated gravimetrically by using the reagent dimethylglyoxime. Draw tin structures of the reagent and that of the precipitated complex. Will the complex be paramagnetic? (3)

30. Answer the following :
   1. What is an icosahedron? For which element, this is the most common structural feature? (2)
   2. Calcium reacts with nitrogen to give an ionic compound A which on hydrolysis yields B and C. Identify A, B and C (3)

I : BIOCHEMISTRY

For each sub-question given below, four alternatives 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.

(20 x 1 = 20)

1. The properties of water include
   a. The ability to form hydrophobic bonds with itself
   b. A disordered structure in the liquid state
   c. A low dielectric constant
   d. Being a dipole, with the negative end at the oxygen atom

2. Deficiency of which one of these enzymes causes defect in the storage of glycogen?
   a. Lactate dehydrogenase
   b. Glyceraldehyde 3 phosphate

c. Phosphorylase
d. Glycogen synthetase

3. The turnover number of chymotrypsin is 100 s^{-1} and for DNA polymerase it is 15 s^{-1}. This means that
   a. Chymotrypsin binds to its substrates with higher affinity than does DNA polymerase
   b. The velocity of the chymotrypsin reaction is always greater than that of DNA polymerase
   c. The velocities of reactions catalysed by both enzymes at saturating substrate levels could be made equal if 6.7 times more DNA polymerase than chymotrypsin were used
   d. The velocities of chymotrypsin reaction at a particular enzyme concentration and saturating substrate levels is lower than that of DNA polymerase reaction under the same conditions

4. Which of the following statements is true? Enzyme catalysis of a chemical reaction
   a. Increases the forward and reverse reaction rates
   b. Decrease $\Delta G'$ so that the reaction can proceed spontaneously
   c. Increases the energy of transition state
   d. Decreases the entropy of reaction

5. Which of the following enzymes can be irreversibly inactivated with Diisopropylfluoridate (DIPF)?
   a. Carboxpeptidase A
   b. Trypin
   c. Lysozyme
   d. EcoRI endonuclease

6. Histories have very high percentage of arginine and lysine residues (15-30%). For this class of proteins which of the following reagents would be a suitable choice for generating peptides in the determination of the amino acid sequence of the protein.
   a. Cyanogen bromide
   b. Thermolysin
   c. Trypsin
   d. N-bromosuccinamide

7. The half-life of ^{32}P phosphate is [illegible] after the purchase of a ba[illegible] the radioactivity present was [illegible] radioactivity on the date of [illegible] would be
   a. 5 mCi
   b. 0.625 mCi
   c. 2.5 mCi
   d. 10 mCi

8. A 100 ml of 0.1 M sodium acetate solution was mixed with 300 ml of 0.3 M sodium acetate. The molarity of the final solution would be
   a. 330 mM
   b. 250 mM
   c. 200 mM
   d. 400 mM

9. A double stranded DNA has 30% Thymine. The percentage of Cytosine is
   a. 30%
   b. 20%
   c. 70%
   d. 15%

10. The following type of interaction is mainly responsible for aggregation of proteins in dilute solutions
    a. Hydrogen bonds
    b. Hydrophobic interactions
    c. Disulfide bonds
    d. Peptide bonds

11. The isomerization of this chromophore by light is the first event in visual excitation
    a. Retinol
    b. All-tans retinal
    c. 11-cis retinal
    d. Retinoic acid

12. In the transaminases the cofactor is linked via Schiff bas, formed between the cofactors and the
    a. α-NH_2 group of N-terminal amino acid
    b. β-NH_2 group of asparagine
    c. ε- NH_2 group of lysine
    d. None of the above

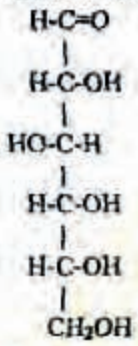
13. An enzyme protein forms 0.001% of the total soluble protein in a crude extract. The degree of purification required to obtain a homogeneous enzyme is
    a. 1000 fold

c. 100,000 fold
d. 10 fold

14. A homogeneous protein of native molecular weight 100,000 gave a single band of molecular weight 50,000 on SDS - PAGE in presence of β-mercaptoethanol. N-terminal analysis gave two amino acids alanine and leucine in equal proportions. Hence the
a. Protein is a homodimer
b. Protein is contaminated with another protein
c. Protein has two polypeptides linked by disulfide bridges
d. None of the above

15. Cholecalciferol (vitamin D), in order to become biologically active undergoes hydroxylation at two positions in the molecule. Hydroxylation at the 25th position is done in the liver whereas hydroxylation at the 1st position occurs in
a. Skin
b. Pancreas
c. Intestine
d. Kidney

16. How many asymmetric carbon atoms are present in the compound whose structure is given below



a. 1
b. 2
c. 3
d. 4

17. Diphtheria toxin inhibits protein synthesis by
a. Causing formation of ADP-EF2 complex
b. Release of peptidyl-t-RNA from the 'P' site

18. Antigenic peptides are pre[illegible]ells by
a. TCR/CD3
b. CD28
c. CTL A4
d. MHC

19. Which of the following statements about cyclic photophosphorylation is not correct?
a. It does not involve NADPH formation
b. It uses electrons supplied by photosystem II
c. It involves a substrate level phosphorylation
d. It does not generate oxygen

20. Which of the following statements about biological membranes is not true?
a. They contain carbohydrates that are covalently bound to proteins and lipids
b. They are large sheet-like structures with closed boundaries
c. They are symmetric because of the symmetric nature of lipid bilayers
d. They contain specific proteins that mediate their distinctive functions

21. Match the entries in column I with those in column 2 and write matching pairs in the answer book. (5 x 1 = 5)

Column I
A. Van der Waals bonds
B. γ- Globulins
C. Tertiary structure
D. Hill-coefficient (n_H)
E. Tunicamycin

Column 2
1. Spatial arrangement of amino acids that are near each other in the linear sequence
2. Glycosylation inhibitor
3. Cooperativity of oxygen binding
4. Involves polarizable atoms
5. Immune protection

22. Answer the following :
A. In the Entner - Doudoroff pathway, 2-keto-3-deoxy-6- phosphogluconate is acted upon by an enzyme resulting in the formation of two 3-carbon

B. Two first order rate constants k_2 and k_3 and one second order rate constant k_1, define k_m by the relationship,

$$K_m = \frac{k_2 + k_3}{k_1}$$

By substituting the appropriate units for the rate constants in this expression, show that K_m must be expressed in terms of concentration. (2)

23. Answer the following :

A. Arsenate, AsO_4^{3-}, is an uncoupling reagent for oxidative phosphorylation but unlike dinitrophenol it does not transport protons across the inner mitochondrial membrane. How might arsenate function as an uncoupler? (3)

B. Removal of the thymus gland from a young animal not only compromises the production of cytotoxic T cells, but also decreases antibody production by B cells. Why is this the case? (2)

24. Answer the following :

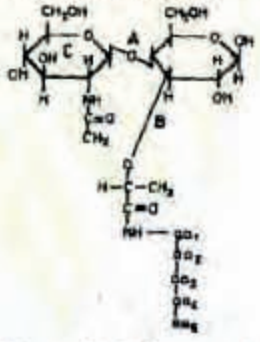
A. Sketch the appropriate plots if the following variables are plotted. Assume that single Michaelis - Menten kinetics apply.

1. v versus [S]
2. [S] versus time
3. [ES] versus time (3 x 1 = 3)

B. When lactose is used as an inducer, there is a lag before the enzymes of the lactose operon are synthesized. With IPTG there is no lag. Explain. (2)

25. Answer the following :

A. The structure of a diner of murein present in bacterial cell wall is represented below.



1. Name the linkage at A
2. Name the linkage at B

B. The DNA in a bacter… …nly labeled with ^{15}N and th… shifted to a growth medium… ^{14}N - labeled DNA precurso… two generations of growth, the D… isolated and is subjected to densi… gradient equilibrium sedimentation… What proportion of light-density DNA to intermediate - density DNA would you expect to find? (2)

26. Answer the following :

A. If $^{18}O_2$ were added to C_3 plants on a bright sunny day, would you expect glycine subsequently isolated from the leaves to be labeled? Explain. (2)

B. Early experiments on the problem of protein folding suggested that the native three dimensional structure of a protein was an automatic consequence of its primary structure. Cite an experimental evidence that shows that this is the case (3)

J : BOTANY

For each sub-question given below, four alternatives are provided of which only 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 x 1 = 25)

1. Microbodies found in cells of fat-rich endosperm are known as
   a. Peroxisomes
   b. Glyoxysomes
   c. Lysosomes
   d. Spherosomes
2. If glucose is the sole respiratory substrate, he respiratory quotient would be
   a. 0.36
   b. 0.80
   c. 1.00
   d. 1.30
3. What role does acetosyringone play in the Agrobacterium mediated gene transfer ?
   a. Induces expression of vir genes
   b. Attaches Agrobacterium to the plants

d. Induces site specific nicks in the bottom strand

4. The processes of guttation in plants usually takes place through certain specialized structures known as
   a. Hydathodes
   b. Nectar glands
   c. Stomata
   d. Trichomes

5. Which of the following amino acids is unable to form a proper peptide bond?
   a. Valine
   b. Cysteine
   c. Arginine
   d. Proline

6. DMSO (Dimethylsulfoxide) is used as
   a. Osmoticum
   b. Cryoprotectant
   c. Gelling agent
   d. Chelating agent

7. Random change in gene and genotype frequencies in small population is termed as
   a. Genetic load
   b. Genetic advance
   c. Genetic equilibrium
   d. Genetic drift

8. Indicate the theory among the following, that relates to "ontogeny repeats phylogeny"
   a. Theory of clonal selection
   b. Theory of natural selection
   c. Theory of recapitulation
   d. Theory of speciation

9. The enzyme responsible for movement of genetic element around the genome is
   a. DNA helicase
   b. Primase
   c. Transposase
   d. Reverse transcriptase

10. Which of the following seed is used for commercial crop production ?
    a. Breeders seed
    b. Certified seed
    c. Foundation seed
    d. Registered seed

b. A series of consumers
c. A collection of pr... decomposers
d. A matrix of food chain

12. A plant cell where nucleus is absent
    a. Sieve tube cell
    b. Guard cell
    c. Cambium cell
    d. Companion cell

13. Which of the following phytohormone induces fruit ripening
    a. Ethylene
    b. Abscisic acid
    c. Zeatin
    d. Gibberellins

14. Corn (Zea mays) has a diploid number of 20. The chromosome number in a microspore mother cell would he
    a. 10
    b. 20
    c. 30
    d. 40

15. Among the followings which one is single membrane organelle
    a. Chloroplast
    b. Nucleus
    c. Lysosome
    d. Mitochondria

16. Which one of the following statements about hexose monophosphate shunt is not true?
    a. Major means in the cell by which reduced NADP is produced
    b. Major pathway by which necessary ribose and deoxyribose are supplied in the biosynthesis of nucleotides and nucleic acid
    c. This pathway takes place in cytoplasm and requires oxygen for its entire operation
    d. It leads to synthesis of 28 molecules of ATP

17. A mechanism that can cause a gene to move from one linkage group to another is
    a. Translocation
    b. Inversion
    c. Duplication

18. An amino-acyl synthetase is responsible for
    a. Formation of a peptide bond
    b. Binding of m-RNA to ribosomes
    c. Attaching an amino group to an organic acid
    d. Joining an amino acid to t-RNA
19. How many different kinds of mating can be made in a population containing two alleles ?
    a. 4
    b. 6
    c. 8
    d. More than 8
20. Red rot of sugarcane is caused by
    a. Claviceps purpurea
    b. Cochliolobus miyabeanus
    c. Colletrotrichum falcatum
    d. Cercospora personata
21. Mangroves are specially adapted to aquatic ecosystem because of the presence of
    a. Pneumatophores
    b. Distinct aqueous tissue in leaves
    c. Vivipary
    d. All of the above
22. Which one of the following should be considered a model plant for investigation in molecular genetics ?
    a. Allium cepa
    b. Happlopappus gracilis
    c. Arabidopsis thaliana
    d. Rheo discolor
23. The physiologically receptor state in which a bacterial cell is able to be transformed is called
    a. Lysogenic
    b. Competent
    c. Sensitized
    d. Inducible
24. The type of inflorescence found in Ficus species is
    a. Cyathium
    b. Verticillaster
    c. Hypanthodium
    d. Coenanthium
25. Photooxidation of chlorophyll is prevented
    b. Anthocyanin
    c. Phycobilin
    d. Fucoxanthin
26. Mention the botanical name of the which yield the following products economic importance
    A. Reserpine
    B. Menthol
    C. Quinine
    D. Vincristine
    E. Opium (5)
27. Answer the following :
    A. Enumerate three important advantages of liquid culture in micro-propagation of plants. (3)
    B. List two factors that affect the extent of somaclonal variation. (2)
28. Answer the following :
    a. What is a maintainer line in hybrid seed industry? (2)
    b. How does incompatibility differs from male sterility ? (3)
29. Answer the following :
    A. What are the differences in the mechanism of CO_2 fixation between most C_4 plants and those exhibiting Crassulacean acid metabolism? (3)
    B. What is Diffusion Pressure Deficit (DPD) and how it is expressed? (2)
30. Answer the following :
    A. DNA based molecular markers have acted as versatile tool in plant genome analysis. State three properties desirable for an ideal DNA marker. (3)
    B. The cloning vectors currently used have one component in common (in addition to origin of replication). Name the component and indicate its function. (2)

K : MICROBIOLOGY

For each sub-question given below, four alternatives 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.

1. Which one of the following statements is correct?
   a. Gram +ve bacteria lack peptidoglycan
   b. Gram -ve bacteria lack peptidoglycan.
   c. Both Gram +ve and Gram -ve bacteria possess peptidoglycan and the outer membrane.
   d. Both Gram +ve and Gram -ve bacteria possess peptidoglycan but the Gram +ve bacteria lack outer membrane.
2. For infection of Escherichia coil with the lambda phage, the E. coli is usually grown in a medium containing maltose because
   a. Maltose is essential for the lysis of E. coli.
   b. Maltose serves as an important cofactor during the phage DNA replication.
   c. The presence of maltose induces maltose binding protein which is inhibitory to bacterial growth.
   d. The presence of maltose induces maltose binding protein which also serves as a receptor for the lambda phage.
3. Which of the following statements about the Archaebacteria group of organisms is incorrect?
   a. Archaebacterial initiator tRNA carries methionine instead of formyl methionine.
   b. Archaebacterial ribosomes, like the eukaryotic ribosomes, are sensitive to anisomycin but insensitive to Chloramphenicol.
   c. Archaebacterial RNA polymerase is insensitive to rifampicin.
   d. Archaebacterial genomic DNA contain base modifications which make it refractile to cleavage with restriction endonucleases prepared from eubacteria.
4. Walking pneumoniae (atypical pneumoniae) affects human beings in the age group of 5 to 25 years. The main causative agent of this disease is
   a. Mycobacterium tuberculosis
   b. Klebsiella pneumoniae
5. Which of the following [illegible] is used for generalized transduc[illegible]
   a. φ x 174
   b. M13
   c. Lambda
   d. P1
6. Which of the following statements is incorrect?
   a. During conjugation of an F^+ (donor) and F^- (recipient) E. coli, a copy of the F factor is almost always transferred to the recipient.
   b. Conjugation between Hfr strain and F^- strain leaves the recipient strain F^-.
   c. Conjugation between Hfr strain and F^- strains results in high frequency of recombination and therefore the recipient become Hit or F.
   d. Conjugation between F^+ and F^- strains results in the recipient becoming F^+.
7. For which of the following property does the A-form double helix DNA not differ from that of B-form double helix?
   a. Appearance of the major and minor grooves
   b. Thickness of the helix
   c. Tilt of the bases
   d. Polarity of the two complementary strands
8. Organellar protein synthesis occurs
   a. Only in mitochondria
   b. An mitochondria as well as in chloroplast
   c. In endoplasmic reticulum
   d. In lysosome
9. Which of the following characteristics holds true for procaryotes but not for eukaryotes?
   a. Motility by cilia
   b. Phospholipids in plasma membrane
   c. Peptidoglycan in the cell wall
   d. DNA as the genetic material
10. Oncogenic retroviruses change normal mammalian cells into cancerous cells. This transformation is primarily associated with
    a. Release of numerous viral particles and concomitant death of the host cells
    b. Integration of the viral genome into the

c. Presence of viral particles in the host cell membrane
d. Efficient replication of the viral genomic RNA in the host cells

11. Which of the following is not a peptide antibiotic?
a. Polymyxins
b. Gramicidins
c. Chloramphenicol
d. Tyrocidines

12. The group of organisms which uses light as the energy source and CO_2 as the principal carbon source are called
a. Photoheterotrophs
b. Chemoautotrophs
c. Chemoheterotrophs
d. Photoautotrophs

13. Which of the following bacteria are capable of oxidizing nitrite to nitrate in the soil?
a. Nitrosomonas
b. Nitrobacter
c. Nitrospira
d. Nitrosococcus

14. Which of the following statements on photorespiration is incorrect?
a. It occurs only in photosynthetic cells.
b. NAD^+ is reduced to NADH.
c. No ATP molecules are formed.
d. H_2O_2 is formed.

15. How many ATP molecules are generated in complete biological oxidation of one molecule of glucose?
a. 36 ATP
b. 12 ATP
c. 30 ATP
d. 38 ATP

16. Which of the following viral infection often leads to hepatocelluar carcinoma in humans?
a. Hepatitis A virus
b. Hepatitis C virus
c. Polio virus
d. human rhino virus

17. The replication of the polio virus positive strand RNA genome requires
a. Virus encoded RNA dependent RNA
b. DNA dependent RNA
c. DNA polymerase
d. Reverse transcriptase

18. The drug colchicine exerts its in action during which of the follo phases of the cell cycle?
a. G0
b. G1
c. G2
d. M

19. Which of the following statements is wrong?
a. Lactic acid is produced by Lactobacillus delbrueckii
b. Bacterial amylase is produced by Bacillus subtilis.
c. Citric acid is produced by Rhizopus nigricans.
d. Gibberellic acid is produced by Fusarium monoliforme.

20. During DNA replication, the synthesis of the leading strand occurs in the 5'-3' direction along with the movement of the replication fork. Which one of the following statements is true about the synthesis of the lagging strand?
a. DNA polymerase II, which has an additional activity of polymerization in 3'–5' direction, is utilized.
b. DNA polymerase I is utilized which can carry out DNA synthesis in the absence of any primer.
c. Synthesis of the lagging strand occurs in the small fragments by DNA polymerase in 5'-3' direction using a de novo synthesized DNA primer.
d. Synthesis of the lagging strand occurs in small fragments in 5'-3' direction utilizing RNA primers.

21. Write whether the statements made below are True or False. (1 x 5 = 5)
a. T-helper lymphocytes secrete a factor which stimulates formation of other types of lymphocytes.
b. T-suppressor lymphocytes cause lowering of the intensity of the immune response.
c. T-cytotoxic lymphocytes recognise nonself antigens on cells and lyse

d. B-lymphocytes develop into cells that secrete antibodies.

e. Hypersensitivity to pollen can be cured by repeated injection with pollen in order to boost levels of IgG in the circulation.

22. Answer the following :

A. Write the name of the enzyme involved in maintenance of chromosomal ends'. What are the major components of the enzyme? (2)

B. Chromosomes contain DNA folded into different order structures. The first order structure corresponds to formation of nucleosomes wherein about 200 bp are wrapped around the histories. The diameter of the nucleosomes is about 11 nm. The nucleosomes are folded further into a second order structure to form a super helix (solenoid) consisting of 6 nucleosomes per turn.

Calculate the total packaging ratio of DNA at the level of nucleosomes and the solenoid. Further lithe genome size of a eukaryotic microorganism is 2×10^7 bp and the size of its chromosome is 4 µm, what will be the final packaging ratio of DNA in the chromosome? (3)

23. Match the function (panel B) of the enzymes listed in panel A. (1 x 5 = 5)

Panel A

A. Reverse transcriptase

B. DNA polymerase

C. RNA polymerase

D. Alkaline phosphatase

E. DNA ligase

Panel B

1. Joining of 5'-PO_4 with the 3' OH in double stranded DNA

2. Synthesis of RNA using DNA as template

3. DNA directed DNA synthesis during DNA replication

4. Synthesis of complementary DNA from RNA

5. Removal of phosphate groups from the terminii of DNA and RNA molecules

A. Mononucleotide, di- and trinucleotide fractions of transcription reaction were Predict phosphate to nucleosi in these fractions.

B. What is the nature of sugar puckeri at 2/3 position in A and B forms of DNA double helices? (2)

25. Under laboratory conditions in a rich nutrient medium E. coli was found to have a doubling time of 20 mm during the exponential phase of growth (Figure 1).

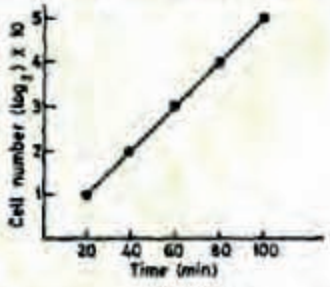


Figure 1

A. What is the property of a synchronously growing culture? How would you determine if the growth curve shown in Figure 1 corresponded to a synchronously growing culture? (3)

B. What is apoptosis and what will be the state of the charomatin in an apoptotic cell? (2)

26. Answer the following :

A. Children are given triple antigen vaccine to protect them against certain bacterial diseases. Name the diseases and the corresponding causative bacteria. (3)

B. What cell types does human immuno deficiency virus (HIV) infect? What receptor on these cells is used for the entry of this virus into these cells? (2)

L : ZOOLOGY

For each sub-question given below, four alternatives 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. (20 x 1=20)

1. Glucagon is produced by
   a. Acinar cells of pancreas
   b. Alpha cells of the islets of langerhans of pancreas
   c. Beta cells of the islets of langerhans of pancreas
   d. All of the above
2. Sympatric populations show
   a. Populations whose geographic ranges overlap
   b. Populations showing similar adaptations
   c. Populations showing similar behaviour
   d. Populations at the verge of extinction
3. The cells that actively synthesize spongy bone are called
   a. Osteocytes
   b. Osteoclasts
   c. Osteoblasts
   d. Osteon
4. A dioecious, triploblastic, pseudocoelomate, bilaterally symmetrical animal with unsegmented body possessing mouth and anus and showing some degree of cephalisation at the anterior end belongs to the phylum
   a. Annelida
   b. Nematoda
   c. Platyhelminthes
   d. Mollusca
5. Which of the following is an example of transition mutation?
   a. A replaced by T
   b. A replaced by C
   c. A replaced by G
   d. A replaced by any base
6. During which one of the following periods, first mammals appeared on the earth?
   a. Devonian
   b. Silurian
   c. Triasic
   d. Jurassic
7. If a single strand of DNA molecule reads as 5'-ACCTAG-3', which one of the following is the complementary RNA molecule?
   b. 5'-TGGATC-3'
   c. 3'-UGGAUC-5'
   d. 5'-UGGAUC-3'
8. A frog exhibits
   a. Cutaneons respiration only
   b. Buccal respiration only
   c. Pulmonary respiration only
   d. All of the above
9. The correct order for respiratory quotient for the following substrates is
   a. Carbohydrate > Protein Fat
   b. Fat > Protein > Carbohydrate
   c. Protein > Carbohydrate > Fat
   d. Carbohydrate > FM > Protein
10. Study involving DNA differences suggests that chimpanzees ate more closely related to
    a. Humans
    b. Gibbons
    c. Capuchins
    d. Rhesus Monkeies
11. The kingdom protista contains
    a. Prokaryotic unicellular autotrophic organisms
    b. Eukaryotic unicellular photosynthetic organisms
    c. Prokaryotic multicellular heterotrophic organisms
    d. Eukaryotic multicellular heterotrophic organisms
12. There are five major classes of Immunoglobulin molecules. Which one of them is produced early during the immune response?
    a. Ig G
    b. Ig A
    c. Ig M
    d. Ig D
13. A baby born to which one of these couples is most likely to suffer from hemolytic disease of the new born?
    a. Rh^+ mother and Rh^+ father
    b. Rh^+ mother and Rh^- father
    c. Rh^- mother and Rh^- father
    d. Rh^- mother and Rh^+ father
14. If a cell has no rigid cell wall, has no chloroplast or plastids, and the stored

carbohydrate is glycogen, then the cell is from

a. Plant
b. Fungus
c. Bacteria
d. Animal

15. In humans, the implantation of blastocyst occurs at

a. Immediately after ovulation
b. 1-2 days after ovulation
c. 6-8 days after ovulation
d. 2-5 days after ovulation

16. The pattern of growth in primate is

a. Limited and allometric
b. Limited and isometric
c. Unlimited and isometric
d. Unlimited and allometric

17. Homeotic mutations result in

a. Loss of Homeostasis
b. Loss of homing of proteins to their targets
c. Deletion of body parts
d. Conversion of one body part to another

18. Bacillary dysentery is produced by the organism belonging to the genes

a. Bacillus
b. Shigella
c. Mycobacterium
d. Clostridium

19. Mitotic spindle is formed by bundles of

a. Microtubules
b. Microfilaments
c. Microbodies
d. Intermediate filaments

20. Interpretation of behavioral data in terms of human experience is called

a. Anthropocentrism
b. Anthropomorphism
c. Teleology
d. Ethlogy

21. Match the Scientists in Column I with their contributions in column II (5 x 1 = 5)

Column I

A. Berk and Sharp
B. Singer and Nicholson
C. Hawes and Spiegelman
E. Baltimore and Temin

Column II

1. Reverse Transcriptase
2. RNA dependent RNA polymerase
3. Fluid-mosaic model
4. RNA splicing
5. Polio vaccine
6. DNA is genetic material
7. Cretaceous mass extinction

22. Provide brief and precise answer to each of the questions

Define the following: (5 x 1 = 5)

A. Semispecies
B. Primitive streak
C. Batesian mimicry
D. Cistron
E. Paratope

23. Provide brief and precise answer to each of the questions :

A. Colour blindness is a sex-linked recessive trait in humans. A normal woman, who had a colour-blind father, marries a colour-blind man (3 x 1 = 3)

1. What is the probability that her sons will be colour-blind?

If the same woman marries a normal man

2. What is the probability of her having a colour-blind child?
3. What is the probability of getting a colour-blind daughter?

B. What is autophagy and what is its function? (2)

24. Provide brief and precise answer to each of the questions :

A. What are oncogenes and Tumor suppressor genes? (2)

B. Why would depletion of ozone in atmosphere lead to increased incidence of skin cancer? (3)

25. Provide brief and precise answer to each of the questions :

A. Cloning sheep Dolly proved that the somatic cells of animals are also totipotent: Explain. (3)

B. Why one produces long term immunity against measles virus after single

26. Provide brief and precise answer to each of the questions :

A. What is the consequence of haploid parthenogenesis in honey bee? (3)

B. What is eutrophication of a lake ecosystem? (2)

M : BIOTECHNOLOGY

For each sub-question given below, four alternatives 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 x 1 = 25)

1. The substrate for restriction enzyme is
   a. Single stranded RNA
   b. Partially double stranded RNA
   c. Cell wall proteins
   d. Double stranded DNA
2. The G + C content of bacteriophage I3 double standed DNA is 68%. What would you expect the G + C content of its mRNA?
   a. About 68%
   b. About 34%
   c. About 32%
   d. About 86%
3. DNA helicases catalyse the reaction
   a. DNA supercoiling
   b. DNA unwinding
   c. Cleavage of DNA helix
   d. Interconversion of DNA topoisomers
4. In human populations, 4% of the individuals are hormozygous recessive to a specific RFLP marker. What percentage of individuals does you expect to be heterozygous for this trait?
   a. 4%
   b. 8%
   c. 16%
   d. 32%
5. Rho-dependent and rho-independent transcription termination mechanisms operate in prokaryotes. Rho independent termination mechanism involves
   a. Binding of the rho pr… of the termination element
   b. No protein factors and … secondary structure and run of
   c. Presence of UGA or UAA stop co…
   d. Binding of accessory factors … termination signal
6. Many plasmids have Amp^r marker This implies
   a. The plasmids contain genes for ampicillin biosynthesis
   b. Ampicillin is required for bacterial growth after transformation
   c. The plasmid contains the gene encoding β-lactamase
   d. Ampicillin is essential for cell survival
7. Choose the correct completion of the following statement.

   A fermenter sterilisation in situ is less efficient than Continuous heat sterilisation because
   a. it uses higher temperature for longer time
   b. it uses longer heating time during which heat is lost
   c. it uses larger volume and hence takes longer to cool the medium
   d. it uses steam as the heating source
8. Which of the following has been produced commercially from mammalian cell cultures?
   a. Plasminogen activator
   b. Antibacterial antibiotics
   c. Insulin
   d. Renin
9. Mung bean nuclease could be used for
   a. DNA synthesis
   b. nucleotide hydrolysis
   c. trimming single stranded regions in DNA
   d. removal of phosphate groups from the ends of the DNA
10. Phage T7 promoter containing plasmids are used for over-expression of cloned genes because
    a. their convenient size
    b. their single stranded nature

d. T7 infects E. coli and lysogenizes the cell

11. In eukaryotes the ribosomal RNA genes are transcribed by
    a. Reverse transcriptase
    b. RNA dependent RNA polymerase
    c. RNA polymerase I
    d. RNA polymerase III

12. Yeast artificial chromosome (YAC) is used for
    a. cloning large segments of DNA
    b. cloning only yeast genomic sequences
    c. cloning of only cDNA sequences
    d. all DNA except plant DNA sequences

13. The term protein splicing refers to
    a. Removal of intervening sequences between the genes
    b. Splicing out of introns from RNA
    c. Removal of intervening protein sequences from the translated protein
    d. Joining (splicing) of two different gene products to generate a novel protein

14. Which one of the following is not a requirement for a PCR reaction?
    a. DNA template
    b. Taq polymerase
    c. NTPs
    d. $MgCl_2$

15. In secondary metabolism two distinct phases - trophophase and idiophase refer respectively to
    a. Growth and production phase
    b. Early and late phase
    c. Primary and secondary metabolism
    d. Lag phase and log phase

16. Which of the following eukaryotic organisms has been proven to be of great industrial importance?
    a. Penicillium chrysogenum
    b. Saccharomyces cerevisiae
    c. Bacillus subtilis
    d. Streptomyces griseus

17. Plant breeders have an advantage over animal breeders in reproducing a desired type offspring because the plant beeders can employ
    a. Gene mutations
    c. Clonal propagation
    d. Selection

18. Which one of the following optio... to the following statement is incor... comparison to physical/chemical me... of clean up, bioremediation methods
    a. Use relatively simple techniques
    b. Generally end up with hazardous waste material
    c. Are relatively slow
    d. Are unobtrusive and non-disruptive

19. Abzymes are
    a. Enzymes that are highly specific like antibodies
    b. Antibodies that have catalytic activities
    c. Also referred to as zymogens
    d. Enzymes which hydrolyze antibodies

20. cDNA made from the mRNA of an organism was used to make a cDNA library in a vector that allows the expression as a fusion with a reporter tag. What percentage of the cDNA clones is likely to give rise to correct gene products?
    a. 10%
    b. 30%
    c. 50%
    d. 100%

21. Commonly used reporter gene in plant expression vectors is
    a. Ti gene of Agrobacterium tumifaciens
    b. Gus gene
    c. β-lactamase gene
    d. α- amylase gene

22. Which one of the following is not a protease?
    a. Proteosome
    b. Trypsin
    c. Chymotrypsin
    d. Peptidyl tRNA hydrolase

23. The Pasteur Effect is
    a. Inhibition of glucose utilization and lactate accumulation in glycolysis
    b. Sterilisation of milk
    c. Vaccine production
    d. Heat treatment of bacteria

24. Detection of which hormone is the commonly used test for pregnancy in

a. LH
b. FSH
c. Charionic gonadotropin
d. Estrogen

25. PKU is one of the best known hereditory disorders in amino avid metabolism. The defect i attributed to a lesion in one of the following enzymatic activities:
a. Phynylalanine ammonia lyase
b. Phenylalanine hydroxylase
c. Tryosine hydroxylase
d. Phenylalanine transaminase

26. Answer the following :
A. Match the Columns :
Columns A
1. Chemical sequencing of DNA
2. DNA blotting
3. Monoclonal antibodies
4. Reverse transcription
5. Protein sequencing
6. Polymerase chain reaction
Columns B
a. Southern
b. Temin, Baltimore & Dulbecco
c. F. Sanger
d. Maxam and Gilbert
e. Kohler and Milstein
f. K. Mullis (3)
B. If all the steps in a PCR reaction were to work at 100% efficiency, how many micrograms of 1Kb product will be generated from 1 p mole of DNA template after 10 cycles (1 bp = 660 Da) (2)

27. Write whether the following statements are true or false :
A. Three important characteristics in performance of biosensors are selectivity, selectivity and stability
B. Activated sludge process is one of the most common anaerobic sewage treatment method
C. In a fermentor, imp... ase oxygen demand by pr... shear forces
D. A pressure cycle is a type of ... fermentor
E. Monoclonal antibodies are use... extensively in diagnosis of haematopoietic cancers. (5)

28. Answer the following :
A. Explain in one sentence why you can not have monoclonal antibodies which can react with mast cells. (2)
B. What are bispecific monoclonal antibodies? (1)
C. How bispecific monoclonal antibodies can be generated.
Give two methods) (2)

29. Answer the following :
A. What is somatic embryogenesis? (1)
B. What is the difference between direct and indirect somatic embryogenesis? (2)
C. State two methods for direct DNA transfer into plant cells (2)

30. Answer the following :
A. The double stranded DNA molecule of a virus was found by electron microsopy to have a length of 34 μM.
1. How many nucleotide pairs are there in one molecule?
2. How many complete turns of the two polynucleotide chains are present in such a double helix? (1)
B. A protein PZ is present in genetically engineered bacteria at 5% of the total protein (0.1 pico gram) pin cell. 1 ml of log phase culture contains 2×10^8 cells while stationary phase culture contains 1×10^9 cells. The molecular weight of the protein is 30,000 Da and the Avagadro number is 6.02×10^{23} molecules/mole. What is the number of molecules of PZ per cell? Calculate the amount of protein in milligrams in one litre each of log phase and stationary phase cultures. (3)