LIFE SCIENCES

H : CHEMISTRY (COMPULSORY)

Gas constant , $R = 8.314 \ J \ mol^{-1}K^{-1}$
$= 0.0821 \ 1. \ atm. \ mol^{-1} \ K^{-1}$
Faraday constant = 96500 coulombs

For each sub-question given below, four alternatives are provided of which only one 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. For the two gases x and y the respective molecular weights are 40 and 28. The corresponding maximum heat capacity Values ($c_{v.max}$) are 12.43 and 29.09 $JK^{-1}mol^{-1}$.

   The heat capacity ratio (c_p/c_v) are found to be 1.666 and 1.286 respectively. The atomicity of the two gases will be
   a. $x = 1, y = 3$
   b. $x = 1, y = 2$
   c. $x = 2, y = 1$
   d. $x = 3, y = 1$

2. One mole of an ideal gas ($c_v = 20 \ JK^{-1}mol^{-1}$) initially at STP is heated at constant volume to twice its initial temperature. For this process w and q will be
   a. $w = 0, q = 5.46 \ kJ$
   b. $w = q = 0$
   c. $w = q = 5.46 \ kJ$
   d. $w = -5.46 \ kJ, q = 5.46 \ kJ$

3. The cryoscopic constant for water is 1.86. A 0.01 molal solution of aqueous acetic acid produced a depression of 0.0193 °C in the freezing point. Then the degree of dissociation of acetic acid is
   a. 0 %
   b. 7.2 %
   c. 3.6 %

4. The solubility of the given electrolyte is $1.3 \times 10^{-5} \ mol \ l^{-1}$ and K_{sp} is 1.7×10^{-10} The electrolyte is made up of
   a. uni - uni valent ions
   b. uni-di valent ions
   c. uni-tri valent ions
   d. di-tri valent ions

5. The equilibrium constant for the solution phase equilibrium of $KI + I_2 \ \square \ KI_3$ is K_1 at T_1. The value of the equilibrium constant K_2 for the formation of KI_3 at higher temperature T_2 ($T_2 = 2T_1$) will be
   a. $K_1 = K_2$
   b. $K_2 < K_1$
   c. $K_1 < K_2$
   d. $2K_1 = K_2$

6. The Nernst equation for the reduction potential of a half cell reaction at 25°C is given by
   a. $E = E^0 - \dfrac{0.0591}{n} \ln \dfrac{Ox}{Red}$
   b. $E = E^0 + \dfrac{0.0591}{n} \ln \dfrac{Ox}{Red}$
   c. $E = E^0 - \dfrac{RT}{nF} \ln \dfrac{Ox}{Red}$
   d. $E = E^0 + \dfrac{RT}{nF} \log \dfrac{Ox}{Red}$

7. The values of E^0 for the couples K^+/K, Zn^{2+}/Zn, Cd^{2+}/Cd, Ag^+/Ag and $Cn\_$ are $-2.93V$, $-0.76V$, $-0.40V$, $0.80V$ and $0.34V$ respectively. The following colour salt solutions are placed in separate test tubes. If a strip of copper foil is placed each of them, which solution will turn blue?
   a. KNO_3
   b. $Cd(NO_3)_2$
   c. $ZnSO_4$
   d. $AgNO_3$

8. 'A' decomposes to give 'x' by first order process with a rate constant of 6.93×10^{-2}

$0.2 M^{-1} min^{-1}$ To have half-life of 10 min. for both processes should have the concentration of 'A' as

a. 0.1 M
b. 0.5 M
c. 10 M
d. 1.0 M

9. In atomic helium the two electrons present have the spins in the opposite direction. This is in accordance With

a. Aufbau principle
b. Degeneracy of atomic orbitals
c. Pauli's exclusion principle
d. Heisenberg's principle

10. The number of atoms present in a face centered cubic cell is

a. 4
b. 6
c. 12
d. 8

11. The compound with paramagnetic character is

a. CuI
b. $ZnSO_4$
c. $CuSO_4$
d. $HgCl_2$

12. The compound with zero dipole moment is

a. CCl_4
b. CH_3Cl
c. NH_3
d. H_2O

13. Which one of the following compounds has tetrahedral structure?

a. BF_3
b. BF_4
c. XeF_4
d. PCl_5

14. Among the following complex ions, the one having strong absorption in the visible region of the electromagnetic spectrum is

a. $[Ni(H_2O)_6]^{2+}$
b. $[Zn(NCS)_4]^{2-}$
c. $[Fe(SCN)_6]^{3-}$
d. $[HgCl_4]^{2-}$

15. A compound of silicon with a high hardness value (9.15 Mohs scale) is

c. Na_2SiO_3
d. Mg_2Si

16. Benzene is first subjected nitration followed by brominatio product formed is

a. ortho-bromo nitrobenzene
b. para-bromo nitrobenzene
c. meta-bromo nitrobenzene
d. sym. Tri-bromo benzene

17. Treatment of phenol with chloroform and aqueous alkali leads to the formation of

a. Resorcinol
b. Benzaldehyde
c. Benzoic acid
d. Salicylaldehyde

18. The order of reactivity of alcohols towards dehydration reaction is

a. $3^0 > 2^0 > 1^0$
b. $1^0 > 2^0 > 3^0$
c. $2^0 > 1^0 > 3^0$
d. $3^0 > 1^0 > 2^0$

19. 1,3-butadiene when treated with p-benzoquinone in benzene at low temperature (35^0C) leads to the formation of

a. Hydroquinone
b. Benzaldehyde
c. Naphthalene
d. Tetrahydro 1, 4-naphthequinone

20. Among the following alkynes which will form insoluble acetylide with AG^+?

a. 2-butyne
b. 3-pentyne
c. 1-butyne
d. 3-hexyne

21. Match each item in column 1 with the most appropriate one in Column ?(5x1= 5)

Column 1

A. Energy of activation
B. Mercurous chloride
C. Graphite
D. Cryolite
E. Geometric isomerism

Column 2

1. Layer structure
2. 1,2-dibromo ethens

4. Haber's process
5. Arrhenius equation
6. calomel
7. Raoult's law
8. Fused salt electrolysis

22. Answer the following :

A. The normal boiling point of benzene and ethanol are found to be $79.8°C$ and $78.2°C$ respectively. If the corresponding values for the enthalpy of vaporization of the two liquids are 30.76 and 38.57 kJ mol^{-1}, calculate the entropy change for the vaporization process of the two liquids. Comment on the molecular structure of the liquids. (3)

B. At $25°C$, the ionic product of water (K_w) is 5.35×10^{-14}. What will be pH at this temperature ? (2)

23. Answer the following :

A. The standard free energy of formation of $NO_2(g)$ and $N_2O_4(g)$ at $27°C$ 51.31 and 97.89 kJ mol^{-1} respectively. Calculate the K_c for the reaction $27°C$,

$N_2O_4(g) \rightleftharpoons 2NO_2(g)$

B. Chloroform and carbon tetrachloride form an ideal solution at 300K this temperature the vapor pressure of chloroform is 200 mmHg and the of carbon tetrachloride is 116 mmHg. Determine the vapor pressure of solution containing equimolar mixture of the two components.

24. Answer the following :

A. The standard reduction potentials for the reactions are given as follows :

$Sn^{2+} + 2e \rightarrow Sn \quad E° = -0.136\ V$
$Sn^{4+} + 2e \rightarrow Sn^{2+} \quad E° = 0.150\ V$

Calculate the $\Delta G°$ for the reaction $Sn^{4+} + 4e \rightarrow Sn$

B. The molar conductance at infinite dilution of KCl, KNO_3 and $AgNO_3$, pressed as mho.mol^{-1}m^2, are 0.01499, 0.01450 and 0.01334 respectively.

What is the molar conductance of AgCl at infinite dilution?

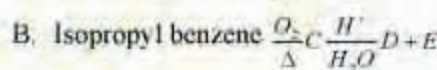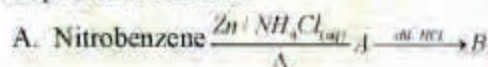25. Answer the following :

A. The following nickel complexes,

Identify the magneti... and explain on the basis of ... theory. [Ni = [Ar] $3d^8\ 4s^2$]

B. To an aqueous solution o... complex having the for... $CoCl_3.5NH_3$ silver nitrate solution w... added. How many moles of AgCl will be precipitated per mole of the complex? Write down the structure of the complex.

26. Write the structure of the compounds A, B, C, D and E formed in the following sequence of reactions

A. Nitrobenzene $\xrightarrow[\Delta]{Zn/NH_4Cl_{(aq)}} A \xrightarrow{dil.\ HCl} B$

B. Isopropyl benzene $\xrightarrow[\Delta]{O_2} C \xrightarrow[H_2O]{H^+} D + E$

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.

$(29 \times 1 = 20)$

1. Which of the following statemtns is incorrect ?

a. Myoglobin consists of a single polypeptide chain in addition to a heme prosthetic group.

b. The red colour associated with the oxygenated forms of myoglobin and hemoglobin is due to heme.

c. Hemoglobin has a higher affinity for oxygen compared to myoglobin as seen from the oxygen binding curves.

d. The α and β chains of the hemoglobin tetramer are slightly shorter than the single chain of myoglobin.

2. The molecular structure of a disaccharide is given below. Identify the compound.
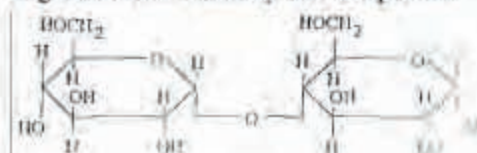
a. Lactose
b. Maltose

d. Cellobiose

3. J chain is a glycopeptide chain associated with which of the following immunoglobulins?

a. IgA

b. IgG

c. IgM

d. IgE

4. Which statement about ribonuclease is correct ?

a. Ribonuclease is an exonucleases

b. The enzyme mediated cleavage occurs at pyrimidine and purine nucleotide residues

c. The hydrolysis product is a polynucleotide with a 5'-phosphate terminus.

d. The hydrolysis product is a polynucleotide with a 3'-phosphate terminus.

5. Molecular weight of an unknown protein can be found out by

a. Electrophoresis

b. Ion-Exchange chromatography

c. Affinity Chromatography

d. None of the above techniques

6. N-terminal amino acids are usually determined by Sanger's method using

a. Ninhydrin Reagent

b. 2, 4, dinitrobenzene

c. Hydrazine

d. Concentrated Nitric Acid

7. Cleavage of the following peptide with Chymotrypsin

$H_3 \overset{\oplus}{N}$ – Gly – Arg – Ala – Ser – Phe – Gly – Asn – Lys – Trp – Glu – Val –$\overset{\ominus}{COO}$

results in

a. 2 fragments

b. 3 fragments

c. 4 fragments

d. No cleavage

8. The average molecular weight of an amino acid in a protein is

a. 112

b. 109

c. 110

9. Which of the following be easily detected by absorbance

1. Leu – Tyr – Met – Ala — Gl

2. Ser – Thr –Thp – Val — Ile – L

3. Ac – Ala – Glu – Gln – Ser – As Lys

4. Thr – Tyr – Trp – Val – Ile

a. 1, 2, and 4

b. 1 and 4

c. 2 and 3

d. 2 and 4

10. Phospholipids containing cyclopropane rings have

a. A higher Tm than saturated acyl chains of the same length

b. Closer packing of the acyl chains in the gel phase

c. Greater fluidity in membranes that they form a part of

d. All of the above

11. The oxygen saturation curves for two oxygen binding proteins are shown in the figure below. Each protein binds four oxygen. Which protein has a higher affinity for oxygen ?

a. Protein A

b. Protein B

c. Both Proteins A and B

d. None of the proteins

12. The formation of glucose in photochemical reactions involves the reduction of CO_2 with the production of O_2. For this process which of the following agents is responsible

a. $FADH^+$

b. $NADPH^+$

c. ADP

d. None of these

13. Although T-cell and B-cell membranes contain some shared reception, the

a. Pokeweed nitrogen (PWM)

b. Phyto hemaggintigin (PHA)

c. Concanavalin A(con A)

d. Sheep red blood cells (SRBCs)

14. Most antibodies are synthesised by the

a. Central lymphoid organs

b. Peripheral lymphoid organs

c. Primary lymphoid organs

d. Macrophages

15. Of the immunological techniques commonly used

a. Enzyme-linked immunosorbent assay (ELISA) can be used to assay antibodies only

b. Immunoelectrophoresis can be used to determine the concentration of IgG because of its cathodic migration

c. The precipitation pattern in immuno-diffusion cannot detect antigenic relationship

d. Radioimmunoassay (RIA) is used for quantitation of any substance that is immunogenic or haptenic

16. Immunosuppressive measure are most effective when administered

a. Just prior to antigen exposure

b. One week before antigen exposure

c. At the lime of antigen exposure

d. Following antigen exposure

17. Which statement about oxidative phosphorylation is not true

a. The five assemblies of proteins and cofactors involved include the electron transferring complex I-IV and ATP synthase.

b. The mobile carrier ubiquinone links complexes I and II with complex III and cytochrome C links complex III with complex IV.

c. For every two electrons transferred from NADH to Q by complex I, two protons are translocated to the intermembrane space.

d. FAD, FMN, iron-sulphur clusters and copper atoms are other cofactors that participate in electron transfer.

18. Z DNA is a third type of DNA helix with structure

c. GCTAAT

d. CGCGCG

19. The TATA Box plays a key assembling active transcription con by

a. Binding with TATA Box-binding protein

b. Binding with DNA protein

c. Binding with RNA protein

d. It does not bind with any protein

20. The order of the predicted rate of diffusion across a lipid bilayer (highest to lowest) is

a. Toluene, galactose, phenylalanine, chloride ion

b. Chloride ion, phenylalanine galactose, toluene

c. Galactose phenylalanine, chloride ion, toluene

d. Toluene, phenylalanine, galactose, chloride ion

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

Column 1

A. Hexokinase

B. Pyruvate dehydrogenase

C. Aconitase

D. Succinate dehydrogenase

E. Ribulose diphosphate carboxylase

Column 2

1. Isocitrate

2. 3-phosphoglycerate

3. Glucose 6-phosphate

4. Acetyl Co A

5. Fumarate

22. Answer the following :

A. What are the immediate consequences of a limitation in the following factors on the rate of photosynthesis ?

a. Light and CO_2

b. The rate electron transport

c. The activity of RuBisCO (3)

B. The two ionizable –OH groups of the phosphate group in α–D-ribose 5-phosphate have pKa values of 1.2 and 6.6. What is the structure of the predominant form at physiological pH?

A. In aqueous solutions below pH 3.0, the synthetic polypeptide polyglutamate, forms regions of α-helices. Above pH 5.0 it assumes an extended conformation. Explain this observation. (2)

At what pH would polylysine be likely to form α-helices ? (1)

B. In glycolysis, there are two reactions that require one ATP each and two reactions that require one ATP each and two reactions that produce one ATP each. This being the case, how can glycolysis of glucose to lactate lead to the net production of two ATP molecules per glucose molecule ? (2)

24. Answer the following :

A. The transformation of glucose to fructose-6-phosphate occurs as follows:

glucose + ATP → glucose-6-phosphate + ADP

$\Delta G^{\circ} = -4.0$ kcal/mol

Glucose -6-phoshate → fructose-6-phosphate
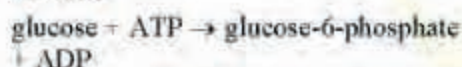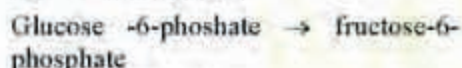
$\Delta G^{\circ} = +4.0$ kcal/mol

Calculate the standard free energy change and the equilibrium constant for this transformation at 25° C. (3)

B. What are the main features of a zinc finger ? (2)

25. Answer the following :

A. In vitro sequencing reactions are commonly carried out at 65°C and usually employ a DNA polymerase isolated from bacterial that grow at high temperatures. What is the advantage of this ? (2)

B. What are the main features of the enzyme linked immunosorbent assay (ELLISA) method ? (3)

26. Answer the following :

A. The chromosome of a certain bacterium is a circular, double-stranded DNA molecule of 5.2 x 10^{6} base pairs. The rate of replication-fork movement is 1000 nucleotides per second. Calculate the time required to replicate the chromosome. (2)

vector. What factors for maximizing the e transcription and translat expression vector is

1. a eukaryotic vector
2. a prokaryotic vector
3. a fusion-protein vector (3)

J : BOTANY

For each sub-question given below, four alternatives are provided of which 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. Which of the following compounds is the immediate source of oxygen produced by photosynthesis?

a. Carbon dioxide
b. Carbon monoxide
c. Water
d. Chlorophyll

2. Cell wall polysaccharides are synthesized mainly in

a. Cytosol
b. Golgi apparatus
c. Endoplasmic reticulum
d. Plasma membrane

3. Which of the following is the most abundant protein in leaves?

a. Chlorophyll a/b binding protein
b. ATP syntheses
c. Rihulose-1,5,bisphosphate carboxylase
d. Globulins

4. What roles do opines play in crown gall diseases?

a. Source of carbon, nitrogen and energy for the Agrobacterium
b. Transfer of TDNA to plant cells
c. Attachment of Agrobacterium to the plants
d. Induction of the expression of vir genes

5. Lettuce (Lactuca sativa) belongs to the family

a. Craciferae

c. Cucurbitaceae

d. Rosaceae

6. Mitosis occurs between

a. G1 and S phase

b. S phase and G2 phase

c. G2 and G1 phase

d. S phase and G1 phase

7. In plant tissue culture studies one of the major problems is the production of polyphenols in the media. This can be tackled to varying degrees by the inclusion in the media of :

a. Agar

b. Vitamins

c. Sucrose

d. polyvinyl pyrrolidine

8. The enzyme nitrogenase catalyzes the reduction of dinitrogen to ammonia. This molybdenon containing protein requires the following of the reaction

a. NADPH, Fe

b. NADPH, Heme

c. Reduced Ferredoxin, ATP, Fe

d. NADPH, ATP, Heme

9. In which of the following regions of the electromagnetic spectrum will Chlorphyll absorb light maximally ?

a. Green

b. Red

c. Yellow

d. Far Red

10. Which of the following phytohormones play a role in seed germination ?

a. Gibberellins

b. Cytokinins

c. Auxins

d. Abscissic acid

11. Tonoplast is defined as

a. the plastid of meristematic cells

b. the membrane of plant vacuoles

c. the membrane of mitochondria

d. the membrane surrounding the chloroplast

12. Which of the following contribute to evolutionary changes ?

a. Comparative anatomy

d. Lack of gene pools

13. The genome of cauliflower m

a. Positive-stranded RNA

b. Single-stranded DNA

c. Double-stranded DNA

d. Double-stranded RNA

14. Which of the following statements about plasmodesmeta is correct ?

a. Like gap junctions, directly connect the cytoplasm of adjacent cells

b. A new site of microtubule and microfilament assembly that appears during late telophase

c. The state of four to six flattened sacs of Golgi apparatus

d. An interconnected network of fibrous proteins that is important in cell structure and for intracellular transport

15. In a double standard DNA, the possible number of reading frames is

a. 2

b. 3

c. 4

d. 6

16. Parthenium is

a. a K selected species

b. an r selected species

c. None of the above

d. Both of the above

17. What percentage of the incident solar energy do plants typically harvest during photosynthesis?

a. 1-2 %

b. 5-10 %

c. 10-20%

d. 20-50 %

18. Photorespiratory pathway in plants involves close cooperation of chloroplasts, mitochondria and

a. Glyoxysomes

b. Peroxisomes

c. Golgibodies

d. Endoplasmic reticulum

19. Chloroplasts may be obtained in a relatively pure form by differential centrifugation of the cell homogenate for 2 minutes at

b. 12,000 x g

c. 1000 x g

d. 144,000 x g

20. The only modified base present in plant DNA is

a. 1-methyl adenosine

b. 7-methyl cytosine

c. 5-methyl cytosine

d. pseudouridine

21. Winch of the following characteristic is correlated with most monocots but not di-cots?

a. absence of reticulate venation

b. absence of vessels in stem

c. presence of triangular protein bodies

d. presence of raphides

22. A plant genetic engineer wishes to transfer and express a gene horn sunflower into beans. Which of the following would be the vector of choice?

a. Lambda phage

b. pBR322 plasmid

c. Ti plasmid

d. Maize streak virus

23. Identify the compound whose structure is given below
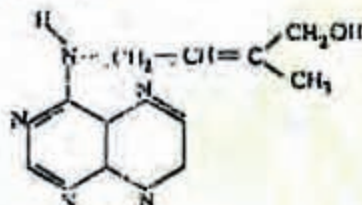
a. Abscissic arid

b. Zeatin

c. gibberellin

d. auxin

24. The theory of Island Biogeography was developed by

a. Darwin

b. Wallace

c. MacArthur and Wilson

d. None of the above

25. Based on biogeographic evidence, the Wallace line separates

a. Australia from New Zealand

b. Australia from Indonesia

d. Japan from Indonesia

26. What are the botanical na following economically impor and to which family do these belong

a. Cotton;

b. Rubber;

c. Coffee;

d. Tobacco;

e. Cacao   (5)

27. Answer the following :

A. What are meristems? Mention briefly about the role of meristems in plant development.   (3)

B. Define the following   (2)

1. Sometic embryogenesis

2. parthenogenesis

28. Answer the following :

A. How do cellulose, pectins and hemicelluloses differ in terms of (i) structure (ii) solubility   (3)

B. What is the main difference between maize transposons Ac and Ds?   (2)

29. Answer the following :

A. Describe briefly the "alternation of generations" as it applies to flowering plants.

B. In Neurospora, a cross between senescent females with normal males gave all senescent progeny. A reciprocal cross of normal females with senescent males gave all normal progeny. What can you conclude about the senescent mutation?   (2)

30. List any five developmental processes that are regulated by phytohormone auxin. (5)

K : MICROBIOLOGY

For each sub-question given below, four alternative answers are provided of which one or more are 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. A bacterium, having doubling time of 10 minutes, fills a cylindrical vessel completely in 3 hours. How much time will it take to fill half of the vessel?

b. 90 minutes

c. 150 minutes

d. 170 minutes

2. The source of hydrogen for reduction of carbon dioxide in purple and green bacterial photosynthesis is

a. H_2O

b. $FADH_2$

c. NADH

d. an organic/inorganic compound

3. Which of the following microorganisms are involved in decreasing soil fertility?

a. Pseudomonas aeruginosa

b. Bacillus denitrificans

c. Nitrosomonas

d. Azotobacter

4. The antibiotic streptomycin was discovered by

a. Alexander Fleming

b. Robert Koch

c. Louis Pasteur

d. S. Waksman

5. Which of the following vitamins is a precursor of coenzyme that is required in enzymatic reactions involving transfer of acyl groups?

a. Lipoic acid

b. Biotin

c. p-Aminobenzoic acid

d. Riboflavin

6. The chemical nature of enveloped viruses is

a. Protein

b. glycolipid

c. lipoprotein

d. nucleoprotein

7. Blastospores in fungi are formed due to

a. binary fission

b. budding

c. fragmentation

d. sexual reproduction

8. For isolation of which group of microorganisms, can agar-agar be used as a solidifying agent?

a. organisms growing up to 30°C

b. organisms growing between 30 - 50°C

9. Mutualistic association be____ ____nd roots of higher plants is know____

a. Mycorrhiza

b. Lichen

c. Legumes

d. Corrralloid roots

10. Alternaria solani causes

a. Early blight of potato

b. Late blight of potato

c. Rust of crucifers

d. Powdery mildew of pea

11. The major functions / features of the Golgi apparatus in encaryotic cells are

a. It carriers out Cure glycosylation of the proteins being transported

b. It is the major protein sorting centre of the cell

c. It forms secretory granules in its trans compartment

d. It consists of lipid bilayer membrane

12. Which one of the choices best completes time statement:

The fact that DNA polymerase I from E. coli has a 5'→3'-exonuclease activity

a. implies that the enzyme has multiple subunits

b. implies that DNA polymerase I can use both DNA and RNA as primers

c. makes the enzyme able to detect thymine dimers in double-stranded DNA.

d. enables the enzyme to play all important role in DNA replication

13. The following sequence best arranges tRNA, rRNA and DNA in order of increasing molecular weights.

a. tRNA, DNA, rRNA

b. tRNA, rRNA, DNA

c. rRNA, tRNA, DNA

d. rRNA, DNA, tRNA

14. Which of the following is the major function of the lymphoid system

a. innate immunity

b. acquired immunity

c. inflammation

d. phagocytosis

15. That DNA is the genetic material can be

a. chromosomes are made of DNA

b. DNA is not present in cytoplasm

c. transformation and transduction in bacteria are caused by DNA only

d. DNA is concentrated in nucleus

16. If the sequence of bases in one strand of DNA is ACGGGTTAT, the sequence of bases in the other strand will be

a. TGCCCAATA

b. GTAAACCGC

c. CGCCAAATG

d. ATAACCCGT

17. If the first base in the segment of DNA, ACGTCGATCCCTATG, get mutated, its effect on coding by this segment will result in

a. No change in the sequence of amino acids

b. one amino acid less in the protein

c. A complete change in the sequence of many amino acids

d. A change of the first amino acid only

18. For a double-stranded DNA molecule, which of the following statements is wrong?

a. A/T ratio is constant

b. C is always equal to C

c. A+T=C+C

d. $(A + 0) / (C + T)$ ratio is constant

19. Chlorine gas is used as a disinfectant in treating water supplies, it kills micro-organisms due to its action as

a. alkylating agent

b. oxidizing agent

c. protein precipitant

d. lipid solvent

20. Which one of the following is known as "pond silk"?

a. Nostoc

b. Laminaria

c. Spirogyra

d. Anabaena

21. Consider the lactose operon of Escherichia coli and match the various genes / DNA sequence elements given in column 1 to their function(s) / feature(s) given in column II. (5x1=5)

B. operator gene

C. CAP binding site

D. Z gene

E. i gene

Column II

1. encodes a protein that interferes with the

2. binding of RNA polymerase

3. bound specifically by RNA polymerase

4. bound- specifically by lac repressor

5. bound specifically by the cAMP - CAP complex

6. is a regulatory gene

7. encodes a galactoside permease

8. encodes a protein that binds allolactose

22. Answer the following :

A. What is the basis of tuberculin test? How can persons suffering from tuberculosis be screened by using this test?

B. Interleukins have played an important role in the development of immune response How are they produced and what are their main functions which lead to this property ?

23. Answer the following :

A. Write down the Koch's postulates which set certain criteria for providing the causal relationship between a microorganism and a specific disease.

B. Give important features of bacteria that lack cell wall.

C. Why is it not possible to culture viruses in cell-free medium ?

24. Answer the following :

A. Why does growth of a microorganism decrease above its optimum growth temperature ? (1)

B. Escheribia coli can derive energy by using both fermentation as well as anaerobic respiration depending on nutritional and environmental conditions. If sodium nitrate is added to a culture of E. coli which is growing fermentatively, would it result in increased yield of the culture? Given reason in support of your answer. (2)

the culture is in its log phase of growth, it is used to inoculna dhwen medium which contains glucose as the sole source of carbon and d instead of lactose (all other medium ingredients remain the same). Assume that all lactose was consumed at the item of transfer of the inocalj to the new medium. Depict the nature of the growth curve of the bacterial in the new medium. (2)

25. Answer the following :

A. Write down a complete reaction (with substrates, products, enzymes and coenzymes) of the glycolytic pathway which exhibits substrate- level phosphorylation mode of energy generation. (1)

B. Write down the first (the activation) step of the metabolic pathway used by sulfate-reducing bacteria (such as Desulfovibrio sulfodismaums) in reducing sulfate to hydrogen sulfide. (2)

C. Certain sulfate-reducing bacterial carry out disproportionation reaction for energy metabolism using sulfur compounds of intermediate oxidation state. Write down the chemical reaction used by the bacteria for disproportionation of sulfite for energy generation. (2)

26. Define the following :

a. Regulon
b. Regulatory mutants
c. Catabolite repression
d. BOD
e. Biocontrol (5 x 1 = 5)

L : ZOOLOGY

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

(20 x 1 = 20)

1. The invertebrate Peripatu[s] [is said] to be a primitive form of the fo[rm]
   a. Mollusca
   b. Annelida
   c. Arthropoda
   d. Coelenterata

2. The correct statement amongst the following is
   a. All invertebrates are also chordates
   b. All vertebrates are also chordates
   c. All chordates are also vertebrates
   d. Vertebrates and chordates are synonymous

3. The term 'Jurassic' in geological time scale refers to
   a. Era
   b. Age
   c. Epoch
   d. Period

4. The compound central to most of the reaction pathways leading to the abiotic formation of simple organic compounds containing nitrogen is
   a. Hydrogen cyanide
   b. Amino nitrile
   c. Glycine
   d. Adenine

5. Twin birth occurs in humans. In tins context dizygotic twins
   a. share identical phenotypic and genotypic traits
   b. do not share both phenotypic and genotypic traits
   c. share identical phenotypic traits
   d. share identical genotypic traits

6. Somatic recombination is commonly found and is important for bioogical function of
   a. Hepatocytes
   b. Lymphocytes
   c. Monocytes
   d. Keratinocytes

7. For radiolabelling DNA with 32P using enzyme DNA-dependent DNA polymerase, one would use :
   a. α^{32} dATP
   b. α^{32} [d]ATP

d. γ^{32} P dATP

8. The prosthetic group in the respiratory pigment haemocyanin is
   a. Iron
   b. Cobalt
   c. Zinc
   d. Copper

9. The organelle not containing nucleic acid is
   a. Rough endoplasmic reticulum
   b. Nucleus
   c. Mitochondria
   d. Golgi apparatus

10. In mammals oogenesis is initiated during fetal development, but the germ cells are:
    a. Arrested at the 1st meiotic prophase
    b. Are capable of undergoing fertilization
    c. Like diploid cells
    d. Capable of undergoing mitosis

11. With regard to two hormones, Chorionic gonadotrophin and luteinising hormone, the statement that is correct is
    a. They are structurally identical
    b. They have similar biological activity
    c. They are produced by anterior pituitary gland
    d. Each of them is made up of a single polypeptide chain

12. At any given time, the veins of the human body hold about the following percentage of total blood volume
    a. 25 %
    b. 50 %
    c. 75 %
    d. 15 %

13. The maximum number of antigen molecules a single I_gG can bind is
    a. 1
    b. 2
    c. 4
    d. 10

14. The causative organism of sleeping sickness is
    a. Trypanosoma
    b. Wuchereria
    c. Ascaris

15. It is possible to obtain _____ by transplanting donor nucleus _____ enucleated oocyte. If the donor _____ from sheep 'A' and the recipient _____ from sheep 'B', the offspring born _____ this embryo is
    a. Genetically identical to only sheep 'A'
    b. Genetically identical to only sheep B
    c. Share genetic traits of both A and B
    d. Have genetic trait totally different from sheep A and sheep B

16. The morphogen required for mesoderm induction during xenopus development is
    a. Albumin
    b. Inhibin
    c. Vitellogenin
    d. Activin

17. A water body near agricultural fields contains aquatic plants, herbivorous and carnivorous fishes and carnivorous birds. The farmers regularly use pesticides in the field. In which organism is the concentration of pesticide likely to be the highest?
    a. Carnivorous birds
    b. Carnivorous fishes
    c. Herbivorous fishes
    d. Aquatic plant

18. All organisms including fauna, flora and microorganisms found in a given area are termed as
    a. Biomass
    b. Biota
    c. Biome
    d. Biosphere

19. Honey bees communicate about the location of food through
    a. Pheromones
    b. Songs
    c. Dance
    d. Touch

20. The most social group of mammals are
    a. Ungulates
    b. Carnivores
    c. Primates
    d. Rodents

21. Match the pair of collaborating scientists

Column A

A. Jacob
B. Bishop
C. Milstein
D. Orgel
E. Messelson

Column B

1. Varmus
2. Stahl
3. Crick
4. Monod
5. Kohler

Column C

a. Monoclonal antibody
b. Selfish DNA
c. Operon hypothesis
d. DNA replication
e. oncogene

22. Define the following :   (5 x 1 = 5)
    a. Dominance hierarchy
    b. Adaptive radiation
    c. Apoptosis
    d. Uricotelism
    e. Transgenic animals

23. Answer the following :
    A. What are the differences between directional and stabilizing selection? Winch one produces evolutionary change?   (3)
    B. 'What are the differences between hemimetabolous and holometabolous metamorphosis?   (2)

24. Answer the following :
    A. Why is it believed that mitochondria was once a free living prokaryote which had established a symbiotic relationship with an ancient unicellular eukaryote which has been selected during evolution ?   (3)
    B. Pictorially depict the cell cycle with all its phases. Name the major events that take place in each phase.   (2)

25. Answer the following :
    A. What is biogeochemical cycle ?
    B. Why would DNA with high G + C content need higher temperature to melt as compared to DNA with high A

C. State the reasons why ~~~~ like Valine, leucine, Isole~~~~ alanine and methionine ~~~~ found internally in a globular p~~~~

26. Answer the following :
    A. Name the antibody molecular hat is present on the surface of virgin B-lymphocyte that functions as receptor for the antigen. How does it differ form the secretory form ? (2)
    B. What is criss cross inheritance ?   (2)
    C. Name the parasite that causes filariasis and which are the endemic areas in India for the disease.   (1)

M : BIOTECHNOLOGY

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

(25 x 1 = 25)

1. Recombinant DNA human health care product developed for treating haemophiliac is
   a. Interferon
   b. Lymphokines
   c. Coagulation factor IX
   d. Phytohaemaglutinin

2. Which of the following features of transcription is similar to that of replication?
   a. No primer is required for polymerization
   b. Polymerization does not have proof reading activity
   c. Newly synthesized strand starts falling off the template before complete RNA is synthesized
   d. RNA synthesis requires DNA Topoisomerase action

3. Terminal transferase is used
   a. To add base at the 3' end of the DNA
   b. Tb add base at the 5' end of the DNA

d. To transfer phosphate at the 3' end of the DNA

4. Which of the following processes in protein synthesis requires hydrolysis of GTP?
   a. Initiation
   b. Elongation
   c. Termination
   d. Post translational modification

5. Which of the following components is necessary for the synthesis of ribosome from RNA?
   a. Ribosomes
   b. DNA polymerase
   c. DNA ligase
   d. Topoisomerase

6. Which of the following will not affect the expression of a cloned foreign gene host?
   a. Promoter strength
   b. codon choice
   c. size of the host genome
   d. Plasmid copy number

7. RNA in a DNA-RNA hybrid is digested by
   a. S_1 nuclease
   b. RNase A
   c. RNase H
   d. RNase T_1

8. Highest capacity vector is
   a. Yeast integrative vector
   b. Yeast artificial chromosome
   c. Cosmid
   d. Bacteriophage vector

9. Production of secondary metabolites requires the use of
   a. Protoplasts
   b. Apical Meristem
   c. Auxiliary buds
   d. Cell suspension

10. Resistance to herbicide glyphosate in transgenic plants is brought about by
    a. Overproduction of RNA polymerase
    b. Underproduction of EPSP synthase
    c. Overproduction of EPSP synthase
    d. Overproduction of Aspartate aminotransferase

11. In plants embryo rescue is adopted for

b. Prezygotic fertilization
c. Culture induced abnormalities
d. Postzygotic fertilization barriers

12. Cytoplasmic male sterility is encoded by
    a. Mitochondria
    b. Chloroplast
    c. Cytosol
    d. Ribosomes

13. The C Value denotes the total amount of DNA in a
    a. Aneuploid
    b. Diploid
    c. Haploid
    d. Polyploid

14. Aminopterine is used during the production of hybridoma cells because
    a. It blocks the salvage pathway
    b. It prevents the growth of B cells
    c. It prevents the growth of myeloma cells
    d. It blocks the synthesis of Ig by B cells

15. Salk and Sabin polio vaccines are
    a. Prepared from two different strains of polio virus
    b. Both are attenuated forms of vaccines
    c. Salk vaccine is attenuated form and Sabin vaccine is inactivated form of vaccines
    d. Salk vaccine is inactivated form and Sabin vaccine is attenuated form of vaccines

16. Which of the following methods can determine the concentration of Hapten ?
    a. Rocket immunoelectrophoresis
    b. ELISA
    c. Ouchterlony immunodiffusion
    d. None of the above

17. cdc mutants are useful for the study of
    a. Chromosome breakpoint
    b. Apoptosis only
    c. Various stages of cell cycle
    d. homeodomain

18. Which of the following cytokines are produced both by T_H1 and T_H2 cells ?
    a. IFN_1

d. IL-4

19. Most Industrial Enzymes are obtained from
   a. Plants
   b. Animal tissues
   c. Microbes
   d. Insects

20. In the conversion of Glucose to Fructose which of the following immobilized enzymes is used in the industry
   a. α–amylase
   b. Lactase
   c. Glucoamylase
   d. Glucose Isomerase

21. For a turbine aeration-agitation unit the Power consumption
   a. is the same for gassed and ungassed systems
   b. increases with decreasing turbine diameter
   c. is smaller for gassed system than for ungassed system
   d. is greater for gassed system than for ungassed system

22. Industrial production of Citric Acid requires
   a. Oxygen, sugars and Saccharomyces cerevisiae
   b. Oxygen, Sugars and Escherichia coli
   c. Oxygen, sugars and Aspergillus niger
   d. Oxygen, Sugars and Acetobacter suboxydans

23. Kia can be measured by sulfite Oxidation Method. The dissolved oxygen concentration measured by dissolved oxygen probe in a sodium sulfite solution will be
   a. Zero
   b. Low
   c. High
   d. Variable

24. Which of the following can be used to count the viable number of cells
   a. Plate count
   b. Turbidity
   c. Dry weight measurement
   d. Coulter Counter

a. Concentration of lim____ is maintained constant
b. High productivity can not be ___
c. Automation is difficult
d. Mutation is less likely to occur

26. Answer the following :
A. Protein X has a mol wt. of 30,000 daltons. Assuming average mol wt of an amino acid is 120 daltons, how many codons are found in the mRNA that codes for this protein (include start and stop codons also) (1)
B. Explain the following observations in one or two sentences. Restriction enzyme 1(RE1) acts at all sites acted upon by Restriction enzymes 2(RE2), yet RE2 can act only at some of the sites acted upon by RE1. (1)
C. With the help of a line diagram given the basic structure of a prokaryotic gene including its 5' regulatory sequences and 3' termination sequence. Label each of the components. (1)
D. In the original PCR (polymerase chain reaction) protocol Klenow DNa polymerase was used which was subsequently replaced by thermostable DNA polymerases. What is the advantage of the latter ? Explain in 1-2 sentences. (1)
E. Following is a schematic representation of the autoradiograph of a DNA sequencing gel obtained with the chain termination method. What is the sequence of the DNA fragment sequenced ? (1)
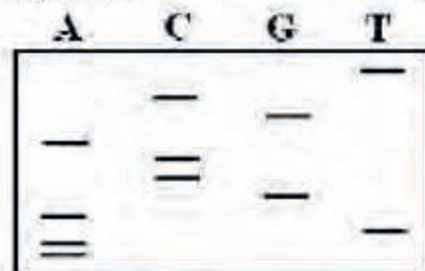
27. Answer the following :
A. List different methods for DNA delivery in plant cells. (1)
B. What do you understand by the following ? Give one example of each

a. Plantibodies
b. Plant vaccines
c. Bioplastics
d. Plants as bioreactors
C. Describe in one sentence why bacterial gene gets poorly expressed in transgenic plants. (1)
D. Describe in one sentence the utility of micropropagation technique in crop improvement. (1)

28. Answer the following :
A. Match the items in Column A with those in Column B

Column A
1. Cell line
2. Hela cells
3. CHO cells
4. Primary cells

Column B
a. Can grow in suspension culture
b. Undergoes senescence and death
c. Can grow indefinitely in culture
d. Needs solid surface for growth

B. Cyclosporine A is added while immortalizing B lymphocytes with Epstein Barr, Virus. Why?
C. Why glutamine is an important component of animal cell culture medium?
D. What is the risk involved in using retroviral vector in making animal transgene?

29. Answer the following :
A. No amino acid side chain is a good electron acceptor yet many enzymes, such as Carboxypeptidase A, catalyze reactions in which enzyme serves as an electron acceptor. How is this accomplished?
B. Can competitive inhibitor be allosteric regulator? Explain in one sentence.
C. An enzyme is active when reduced, but loses its activity when it is treated with iodoacetamide. What amino acid is likely to be responsible for its activity? (1)
D. List out three different methods of immobilization of enzymes. (1)
E. List two factors which lead to decrease in microbial activity in Ethanol fermentation. (1)

30. Answer the following :
A. Derive a simple equation characterizing the self regulating capacity of a Continuous Flow Fermentation process. ($\mu = D$). (1)
B. A bacteria grows on glucose with $\mu_{max} = 0.5$ h^{-1}. The K_s with respect to glucose is 0.05 kg/m^3. What will be the specific growth rate of the bacteria when glucose concentration is 0.5kg/m^3? (1)
C. List two techniques for disintegration of microbial cells. (1)
D. Calculate the doubling time of an organism whose specific growth rate is 0.1 h^{-1}. (1)

31. Assuming that cells convert two thirds (w/w) of the substrate carbon (glucose) to biomass calculate the stoichiometric coefficient (β_1 only) for glucose utilization. (1)

$$C_6H_{12}O_6 + \alpha_1 O_2 + \alpha_2 NH_3 \rightarrow \beta_1 (C_{1.4}H_{7.3}N_{0.86}O_{1.2}) + \beta_2 CO_2 + \beta_3 H_2O$$
(Biomass)