

LIFE SCIENCES

I : CHEMISTRY (COMPULSORY)

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 x 1 = 25)

1. The ground state electronic configuration of iron is $[\text{Ar}] 3d^6 4s^2$. The electronic configuration of ferric iron is
 - a. $[\text{Ar}] 3d^6 4s^0$
 - b. $[\text{Ar}] 3d^4 4s^2$
 - c. $[\text{Ar}] 3d^5 4s^0$
 - d. $[\text{Ar}] 3d^3 4s^2$
2. In fluorite structure the coordination number of calcium is
 - a. 3
 - b. 4
 - c. 6
 - d. 8
3. Nickel forms a stable complex with cyanide ion having the composition $[\text{Ni}(\text{CN})_4]^{2-}$. The atomic number of nickel is 28. The magnetic moment of the complex in Bohr magneton is
 - a. 0
 - b. 1.73
 - c. 2.83
 - d. 3.87
4. Among the following compounds the one that generates H_2O_2 on acidification is
 - a. PbO_2
 - b. MnO_2
 - c. BaO_2
 - d. SnO_2
5. The complex $[\text{Co}(\text{NH}_3)_5\text{Cl}]\text{Cl}_2$ reacts with an aqueous solution of silver nitrate quantitatively. The number of moles of silver chloride formed per mole of the complex is
 - a. 1
 - b. 2
 - c. 3
 - d. 5
6. Among the following the one that is NOT an amphoteric oxide is
 - a. Al_2O_3
 - b. MgO
 - c. ZnO
 - d. SnO
7. The formula of peroxodisulphuric acid is
 - a. H_2SO_5
 - b. $\text{H}_2\text{S}_2\text{O}_3$
 - c. $\text{H}_2\text{S}_2\text{O}_4$
 - d. $\text{H}_2\text{S}_2\text{O}_8$
8. The oxidation states of sulphur atoms in $\text{Na}_2\text{S}_2\text{O}_3$ are
 - a. +2, -6
 - b. +2, +2
 - c. +2, +6
 - d. -2, +6
9. The pair that shows critical solution on temperature in composition - temperature phase diagram is
 - a. phenol - water
 - b. phenol - benzene
 - c. chloroform - water
 - d. methanol - water
10. The van't Hoff factor for a completely dissociated aqueous solution of $\text{K}_4[\text{Fe}(\text{CN})_6]$ is
 - a. 1
 - b. 2
 - c. 3
 - d. 5
11. The solubility product of a sparingly soluble salt, AX_3 in water is 2.7×10^{-31} at 298 K. The solubility of the salt in mol l^{-1} is
 - a. 5×10^{-16}
 - b. 1×10^{-13}
 - c. 4×10^{-11}
 - d. 1×10^{-8}
12. If the standard reduction potential of $\text{Fe}^{3+} / \text{Fe}^{2+}$ is 0.77 V, then the reduction potential
 - a. 3
 - b. 5

- of the electrode Pt / Fe^{3+} (0.1 M), Fe^{2+} (1.0 M) at 298 K is
- 0.67 V
 - 0.71 V
 - 0.77 V
 - 0.83 V
13. Among the following statements the one that is NOT true for a zero order reaction is
- $t_{1/2}$ is directly proportional to the initial concentration of the reactant
 - the time taken for 75% reaction is 1.5 times that of $t_{1/2}$
 - the rate constant has the dimensions of conc. time^{-1}
 - the concentration of the reactant decreases exponentially with time
14. For the gaseous equilibrium $\text{PCl}_5 = \text{PCl}_3 + \text{Cl}_2$, the degree of dissociation of PCl_5 is 0.80 at 1 atm. The degree of dissociation at 2 atm is
- 0.69
 - 0.80
 - 0.85
 - 0.90
15. Among the following the one that is an extensive variable is
- density
 - volume
 - specific heat
 - temperature
16. For an adiabatic irreversible expansion of one mole of an ideal gas
- ΔS (system) > 0 and ΔS (surroundings) $= 0$
 - ΔS (system) $= 0$ and ΔS (surroundings) $= 0$
 - ΔS (system) < 0 and ΔS (surroundings) > 0
 - ΔS (system) > 0 and ΔS (surroundings) < 0
17. Among the following the correct statement is
- pH of water at 333 K less than 7
 - pH of 0.1 M NH_4Cl (aq) $>$ 0.1 M NaCl (aq)
 - pH of 0.1 M CH_3COOH (aq) $<$ 0.1 M HCl (aq)
 - pH of 10^{-8} M HCl is 8
18. Isobutyl alcohol is prepared from the reaction of
- $\text{CH}_3\text{CH}_2\text{MgBr}$ and CH_3CHO
 - CH_3MgBr and $\text{CH}_3\text{CH}_2\text{CHO}$
 - $(\text{CH}_3)_2\text{CHMgBr}$ and HCHO
 - CH_3MgBr and CH_3COCH_3
19. The major product obtained by the dehydration of 1-methylcyclohexanol is
- 1-methylcyclohexene
 - 3-methylcyclohexene
 - 4-methylcyclohexene
 - methylcyclohexane
20. Reaction of aniline with chloroform and KOH produces
- ortho-chloroaniline
 - phenylisocyanide
 - benzoic acid
 - benzenediazonium chloride
21. The major product formed on bromination of acetanilide is
- ortho-bromoacetanilide
 - meta-bromoacetanilide
 - para-bromoacetanilide
 - N-bromoacetanilide
22. Among the following the one that is aromatic is
- cyclohexadienyl cation
 - cycloheptatrienyl cation
 - cyclopentadienyl cation
 - cyclopropyl cation
23. The number of stereoisomers possible for 2-bromo-3-chlorobutane is
- 1
 - 2
 - 3
 - 4
24. The solid product formed by the reaction of ammonia with formaldehyde is
- ammonium formate
 - formaldehyde imine
 - hexamethylenetetramine
 - formamide
25. Conversion of benzaldehyde to cinnamic acid is known as
- Perkin reaction
 - Riemer-Tiemann reaction
 - Cannizzaro reaction
 - Kolbe reaction

26. Answer the following :
- A metal reacts with hot conc. H_2SO_4 to produce a gas (A) and a blue coloured solution. The gas evolved turns acidified dichromate paper to green colour (B). Identify the chemical species (A) and (B). (2)
 - Calculate the de Brogue wavelength in nm associated with a ball weighing 0.15 kg thrown with a velocity of 30 ms^{-1} . (2)
 - Apply phase rule to show that at the normal boiling point of a liquid, the number or degrees of freedom is zero. (1)
27. Match each item in Column A with the most appropriate item in Column B. (5 x 1 = 5)

Column A

- sodium aluminium silicate
- titanium dioxide
- sodium tripolyphosphate
- sodium borohydride
- solid carbon dioxide

Column B

- chelating agent
- reducing agent
- carborundum
- Zeolite
- rutile structure
- silicone
- dry ice

28. Answer the following :
- The molar conductivity of acetic acid ($K_a = 1.8 \times 10^{-5}$) at infinite dilution is $39.0 \times 10 \text{ S m}^2 \text{ mol}^{-1}$. Find the molarity of acetic acid if the measured molar conductivity is $1.56 \times 10^{-3} \text{ S m}^2 \text{ mol}^{-1}$. (2)
 - For a gaseous reaction $\text{A} + \text{B} \rightarrow \text{C}$ at 300 K, $\Delta U = -12.6 \text{ kJ mol}^{-1}$ and $\Delta S = -42.0 \text{ J K}^{-1} \text{ mol}^{-1}$. Calculate ΔG for the reaction. (2)
 - The variation of rate constant for a reaction with temperature is given by the expression

$$\ln k = 30 - [10,000 / T]$$
 Calculate the energy of activation of the reaction. (1)
29. Answer the following :

- Draw the resonance structures of methoxybenzene (anisole). (2)
 - Explain why optically active 2-iodooctane undergoes racemization when reacted with KI acetone? (2)
 - Draw the structure of the enol form of acetylacetone. (1)
30. Answer the following :
- Suggest a suitable method for the synthesis of 3-ethylaniline from acetophenone. (2)
 - Why is it not advisable to use t-butyl chloride and sodium ethoxide to prepare t-butyl ethyl ether? Suggest an alternative method. (2)
 - Write the structures of the Diels-Alder adduct formed from the reaction of cyclopentadiene with dimethyl acetylenedicarboxylate. (1)

J : BIOCHEMISTRY

For each of the sub-question given below, four alternatives are given 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 x 25 = 25)

- Proteins may be separated according to size by,
 - Reverse phase chromatography
 - Ion exchange chromatography
 - Molecular exclusion chromatography
 - Isoelectric focusing
- Which of the following has a quaternary structure?
 - α -chymotrypsin
 - Hemoglobin
 - Insulin
 - Myoglobin
- Which of the following anti-tumour agent acts by impairing the de novo purine synthesis?
 - Cytosine arabinoside
 - 5-fluorouracil
 - Methotrexate
 - Hydroxyurea
- Which of the following is a conservative substitution ?

- a. Val to Ile
 - b. Asp to Pro
 - c. Lys to Leu
 - d. Tip to Ala
5. cAMP activates all except one of the following molecules,
- a. Glycogen phosphorylase
 - b. Hexokinase
 - c. 6-Phosphofructokinase-1-kinase
 - d. Protein kinase A
6. Which of the following statements is correct in case of glycoproteins?
- a. May contain 95 % or more of carbohydrate
 - b. Have the carbohydrate linked to the protein by either N- or O- glycosidic bonds
 - c. Found only on cell membranes
 - d. Always contain a serially repeating carbohydrate unit
7. Phospholipids are involved in all except one of the following,
- a. Cell-cell recognition
 - b. Signal transduction
 - c. Surfactant function in the lungs
 - d. mediator of hypersensitivity
8. Insulin-dependent diabetes mellitus is associated with,
- a. High levels of insulin
 - b. Severe weight gain
 - c. Destruction of β -cells of pancreas
 - d. Mutation of insulin receptor
9. The z-DNA helix,
- a. Has fewer base pairs per turn than the B-DNA
 - b. Is favoured by an alternating GC sequence
 - c. Tends to be found at the 3' end of genes
 - d. Is the most common conformation of DNA
10. Formation of a mature insulin does not include,
- a. Removal of a signal peptide
 - b. Disulfide bond formation
 - c. Removal of a peptide from an internal region
 - d. Cyclization of a glutamate residue
11. How many energy bonds are expended in the formation of a peptide bond?
- a. 2
 - b. 4
 - c. 3
 - d. 6
12. A technique for defining gene arrangement in very long stretches of DNA (50-100 kb) is,
- a. RFLP
 - b. Chromosome walking
 - c. Nick translation
 - d. Southern blotting
13. Receptors for steroid hormones are found,
- a. On cell membranes
 - b. In cytoplasm
 - c. In mitochondria
 - d. On ribosomes
14. Platelet aggregation is,
- a. Initiated at the site of injury by the conversion of fibrinogen to fibrin
 - b. Causes release of serotonin
 - c. Is inhibited by uninjured blood vessels by the secretion of prostacyclins
 - d. Is inhibited by ADP and thromboxane
15. Oral administration of large amounts of tyrosine may interfere with the intestinal absorption of,
- a. Leucine
 - b. Glycine
 - c. Aspartate
 - d. All of the above
16. In the 3-dimensional structure of immunoglobulin G,
- a. Free SH-groups are conserved to function in binding of antigen
 - b. C_H and V_H association form the complementary antigen binding sites
 - c. The predominant secondary structure is α -helix
 - d. Hinge regions connect the globular domains
17. Changes in protein conformation can be detected by,
- a. Ultraviolet absorption spectroscopy
 - b. Fluorescence emission
 - c. Circular dichroism
 - d. All of the above

18. Endonuclease is an enzyme that hydrolyzes,
- A nucleotide at the 3' end of an oligonucleotide
 - A phosphodiester bond located in the interior of a polynucleotide
 - A nucleotide from either terminii of an oligonucleotide
 - A peptide bond located in the interior of a polypeptide
19. The K_m of an enzyme is,
- One half of the V_{max}
 - A dissociation constant
 - The substrate concentration that gives maximal velocity
 - The substrate concentration that gives half maximal velocity
20. The class of immunoglobulins most abundant in body fluids is,
- IgM
 - IgG
 - IgA
 - IgE
21. Which of the following statements is correct in case of chaperone proteins?
- These do not prevent aggregation
 - They cleave incorrect S-S bonds
 - Act on fully synthesized polypeptides
 - Are involved in the transport of proteins across mitochondria and endoplasmic reticulum
22. One of the following participates in phagocytic activities,
- Neutrophils
 - Mast cells
 - T cells
 - Thrombocytes
23. The basal metabolic rate,
- Is not influenced by energy intake
 - Increases in response to starvation
 - Increases in direct proportion to energy expenditure
 - Decreases during periods of starvation
24. Operons,
- Are of approximately uniform in size
 - Do not bind proteins
 - Are found in all eukaryotic genes
 - Are shorter and smaller in lower eukaryotes than higher eukaryotes
25. In humans, fatty acids,
- Can be synthesized from excess dietary carbohydrate or protein
 - Must be supplied entirely by diet
 - Are not required at all in the diet
 - Containing double bonds cannot be synthesized
26. Answer the following :
- Blood groups are determined by the allelic genes A, B and O. These genes code for different enzymes that result in the production of blood group antigens.
What is the nature of these enzymes? (2)
 - Where are Rh antigens found? (1)
 - How many genes determine Rh antigens? (1)
 - Name the immunodominant Rh antigen (1)
27. Match the entries in column I with one appropriate from column II and write matching pairs in the answer books
(1 x 5 = 5)
- Column I
- Apoptosis
 - T cell receptor
 - 5-Hydroxytryptamine
 - β -adrenergic receptor
 - Colchicine
- Column II
- CD3 complex
 - Caspases
 - adenylate cyclase
 - Mitotic spindle
 - Neurotransmitter
 - Immunosuppressive
 - DNA binding protein
28. Answer the following :
- What is the possible number of protein sequence that can be read from a genomic sequence? (1)
 - What are the different activities present in the Klenow fragment? Name the enzyme from which Klenow originates? (2)
 - In order to end-label a DNA molecule at its 5' end, what is the nature of the labeled nucleotide is used? Name the enzyme used. (2)

29. Answer the following : (1 x 5 = 5)
- What effect would the removal of the bursa of fabricius have on chickens?
 - Name the primary lymphoid organs in the adult human.
 - Define monoclonal antibodies.
 - Which are the two isotypes of immunoglobulins that can be simultaneously expressed on naïve B cells?
 - What is the precursor of histamine?
30. A purified enzyme preparation (3 mg/ml) was diluted 10 times. 10 μ l of the diluted enzyme catalyzed the formation of 30 nmoles of product/min under standard assay conditions.
- Express the velocity as μ moles of product/min/mg. (2)
 - What does the velocity expressed in μ moles/min/mg signify? (1)
 - If the molecular weight of the enzyme is 30,000, calculate its turnover Number. (2)

K : BIOTECHNOLOGY

For each sub-questions 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)

- The precursor for penicillin-G biosynthesis during fermentation process is
 - Phenylacetic acid
 - Phenoxyacetic acid
 - Acetic acid
 - None of the above
- Callus formation from mature tissue explant occurs through
 - Dedifferentiation
 - Redifferentiation
 - Both (a) and (b) of the above
 - None of (a) and (b)
- RNA is very much susceptible to hydrolysis in alkali because
 - It contains uracil residues in its structure
 - Its 2'-OH group participate in intramolecular cleavage of phosphodiester backbone
 - Cleavage occurs in the glycosylic bonds of purine bases
 - Cleavage occurs in the glycosylic bonds of pyrimidine bases
- The typical coenzyme present in the methanogens is
 - Coenzyme A
 - Coenzyme Q
 - Coenzyme M
 - None of the above
- Large scale clonal propagation practically means raising a population of plantlets from
 - A single cell
 - A single explant
 - Many explants from a single plant
 - Many explants from a group of plants
- T4 Polynucleotide kinase is used for
 - Labelling 3' ends of DNA
 - Labelling 5' ends of DNA
 - Creating blunt ends of DNA
 - Dephosphorylation of DNA
- Energy capture efficiency of the aerobic cells using glucose as a substrate is
 - 50%
 - 40%
 - 30%
 - 20%
- Plant secondary metabolites production in suspension culture is mainly targeted for
 - Obtaining metabolites in aseptic condition
 - Enhanced in vitro production of desired metabolite
 - Enhanced production of all metabolites
 - Obtaining new metabolites
- A plasmid cloning vector should contains of he following sequences except
 - Origin of replication
 - Inducible promoter
 - Selectable marker gene
 - Multiple cloning sites
- For scaling up of a bioreactor, the following parameter is assumed to be constant
 - Airflow rate

- b. Diameter of the impeller
 c. Agitator speed
 d. Volumetric mass transfer coefficient
11. Stable transformation of plants is reliably obtained by
 a. Agrobacterium plasmid integration
 b. Electroporation
 c. Microinjection
 d. Silicon carbide whisker
12. In baculovirus expression vector foreign genes are expressed from the promoter of
 a. Polyhedrin gene
 b. Bacteriophage T7 gene
 c. E. coli lacZ gene
 d. Yeast phosphoglycerate kinase gene
13. Mechanism of separation of contaminants present in air by fibrous media are
 a. Interception
 b. Inertial impaction
 c. Diffusion
 d. All of the above
14. The length of each hoarder sequence in Ti-plasmid is about
 a. 25 million base pairs
 b. 200 kilo base pairs
 c. 25 kilo base pairs
 d. 25 base pairs
15. Enzyme used in 'cycle' sequencing of DNA is
 a. T7 DNA polymerase
 b. T4 DNA polymerase
 c. Klenow DNA polymerase
 d. Taq DNA polymerase
16. Ethanol concentration is lowest in
 a. Wine
 b. Beer
 c. Brandy
 d. Rum
17. Plastome is
 a. A type of plastid
 b. An organellar genome
 c. Plasmalemma protein
 d. None of A / B / C
18. Recombinant live attenuated vaccine against hepatitis B was prepared from
 a. Plasma of chronically infected individual
 b. Recombinant yeast expressing hepatitis B surface antigen
 c. Recombinant vaccinia virus expressing hepatitis B surface antigen
 d. Transgenic plants expressing hepatitis B surface antigen
19. The following cross-linking agents may be used for the immobilization of enzymes
 a. Glutaraldehyde
 b. Cyanogen bromide
 c. Thionyl chloride
 d. All of the above
20. Which of the following statements is most appropriate for recombinant antibody production in transgenic plants?
 a. A very high level expression is always obtained
 b. Light promote more antibody production
 c. Such antibodies are free from other antigen of animal origin
 d. Functional antibody cannot be produced in plants
21. Cells deficient in hypoxanthine guanine phosphoribosyl transferase (HPRT) enzyme rely on
 a. Synthesis of purine deoxynucleotides by salvage pathway
 b. Synthesis of purine deoxynucleotides by de novo pathway
 c. Supply of hypoxanthine in the culture medium
 d. Supply of thymidine in the culture medium
22. Enhanced axillary branching for multiple shoot production is promoted by
 a. 2,4-D
 b. Abscise acid
 c. Gibberellic acid
 d. Benzyl adenine
23. The following culture systems are used for growing large amount of anchorage dependent animal cells except
 a. Roller bottle
 b. Airlift fermenter
 c. Hollow fibre reactor
 d. Microcarriers
24. Viral replication within cells is inhibited by
 a. IL-4

- b. IL-1
c. IFN α
d. TNF α
25. In large scale fermentation process, air is sterilized by
a. Jute fiber
b. Membrane
c. Cotton fiber
d. Glass wool fiber
26. Match the organisms in Column A with the product in Column B. (5)
- Column A
A. *Thermus aquaticus*
B. *Acetobacter aceti*
C. *Bacillus thuringiensis*
D. *Saccharomyces carlbergensis*
E. *Haemophilus influenzae*
- Column B
1. Beer
2. Bioinsecticides
3. Hind III
4. Taq I
5. Vinegar
27. Match the secondary metabolites in Column A with their most appropriate chemical characteristics in Column B. (5)
- Column A
A. Diosgenin
B. Ajmalicine
C. Shikonin
D. Digoxin
E. Scopolamine
- Column B
1. Holoside
2. Pyrrolizidine alkaloid
3. Indole alkaloid
4. Naphthoquinone nucleus
5. Cardenolide
6. Saponin
7. Tropane alkaloid
28. Answer the following :
a. Name two metal ions which play important role in citric acid fermentation. (1)
b. How is the agitator speed in a fermenter correlated with the power drawn by the agitator? (1)
- c. How does the sulfanilamide kill the bacteria? (1)
d. Human insulin gene cloned from a cDNA library into pUC19 could not be expressed. Justify the reason. (1)
e. Mention the specific role of acetosyringone in *Agrobacterium* mediated plant transformation? (1)
29. Answer the following :
a. The volume of a chemostat system is 1000 l. The feed flow rate to the reactor is 200 l/h and the glucose concentration in the feed is 5 g/l. Determine cell and glucose concentration in the effluent of the reactor under steady state conditions. Use the following constants for the cells:
 $\mu_{max} = 0.3 \text{ h}^{-1}$, $K_s = 0.1 \text{ g/l}$, $Y_{x/s} = 0.4$ (g dw cells / g glucose) (3)
b. Find out the dilution rate which gives maximum biomass productivity. (2)
30. Answer the following :
a. What are the characteristics of 'normal' primary animal cells? (2)
b. Name different methods for the separation of different cell types from a mixed population of animal cells? (2)
c. What is transgene? (1)

L : BOTANY

For each sub-question given below, four alternatives are provided of which only one is correct. Write the correct answer in the answer hook by writing a, b, c or d along with the sub-question number. (25 x 1 = 25)

1. Which of the following cell organelles involved in photorespiration?
a. Peroxisomes
b. Ribosomes
c. Dictyosomes
d. Lysosomes
2. Plasmodesmata connect neighbouring cells, forming a
a. Symplast
b. Apoplast
c. Protoplast
d. Tonoplast

3. Which of the following is wrong for isobilateral leaves?
 - a. Stomata occur on both the epidermis
 - b. Mesophyll tissue is of one kind
 - c. Generally found in monocots
 - d. Presence of palisade and spongy cells
4. Tyloses are found in
 - a. Tracheids
 - b. Xylem vessels
 - c. Xylem parenchyma
 - d. Xylem fibers
5. The loss of liquid water through hydathode is called
 - a. Guttation
 - b. Transpiration
 - c. Secretion
 - d. Bleeding
6. In which phase of the cell cycle the drug colchicine exerts its effect?
 - a. G1
 - b. S
 - c. G2
 - d. M
7. The condition when anthers mature earlier than stigma is known as
 - a. Dicliny
 - b. Herkogamy
 - c. Protandry
 - d. Protogyny
8. The stalk with which the ovule remains attached to the placenta is called
 - a. Funicle
 - b. Hilum
 - c. Micropyle
 - d. Nucellus
9. Viviparous germination is found in
 - a. *Rhizophora* sp.
 - b. *Mangifera* sp.
 - c. *Nymphaea* sp.
 - d. *Typha* sp.
10. Seed storage proteins of legumes are deficient in
 - a. Threonine
 - b. Methionine
 - c. Lysine
 - d. Glycine
11. A hormone that controls closure of stomata in response to water stress is
 - a. Abscisic acid
 - b. Gibberellins
 - c. Ethylene
 - d. Zeatin
12. The process by which a cell secretes macromolecules by fusing a transport vesicle to the plasma membrane is called
 - a. Pinocytosis
 - b. Phagocytosis
 - c. Endocytosis
 - d. Exocytosis
13. When a cell expends energy to move a solute across its membrane against a concentration gradient, the process is called
 - a. Diffusion
 - b. Facilitated diffusion
 - c. Active transport
 - d. Osmosis
14. The CO₂ acceptor in C₄ plants is
 - a. 3-Phosphoglyceric acid
 - b. Ribulose bis-phosphate
 - c. Phosphoenol pyruvic acid
 - d. Xylulose 5-phosphate
15. Absorption maxima of phytochrome (P_f) is
 - a. 660 nm
 - b. 680 nm
 - c. 700 nm
 - d. 730 nm
16. Light harvesting complex II is located in the
 - a. Thylakoid lumen
 - b. Stroma
 - c. Thylakoid membrane
 - d. Outer membrane of chloroplast
17. A known uncoupler of the electron transport chain and oxidative phosphorylation is
 - a. Dinitrophenol
 - b. Ancyimidol
 - c. Triacontanol
 - d. Hexaconazol
18. The chromatin fibers at metaphase have an average diameter of
 - a. 100 Å
 - b. 200 Å
 - c. 300 Å
 - d. 400 Å

19. The maximum frequency of a recombination of genes at two loci is
 a. 25%
 b. 50%
 c. 75%
 d. 100%
20. Symbiotic association between fungi and roots of higher plants is known as
 a. Mycorrhiza
 b. Lichen
 c. Coralloid roots
 d. Epiphytic roots
21. Ergot of rye is caused by
 a. *Fusarium oxysporum*
 b. *Claviceps purpurea*
 c. *Aspergillus niger*
 d. *Alternaria solani*
22. Production of transgenic cotton resistant to lepidopteran insects utilizes a toxin-producing gene isolated from
 a. *Pseudomonas fluorescens*
 b. *Bacillus thuringiensis*
 c. *Bipolaris maydis*
 d. *Clostridium tetani*
23. Hutchinson's phylogenetic system of classification appeared in the volume
 a. *Genera Plantarum*
 b. *Hortus Uplandicus*
 c. *Die Natürlichen Pflanzenfamilien*
 d. *Families of Flowering Plants*
24. Plants occurring on saline soils are called
 a. Hydrophytes
 b. Epiphytes
 c. Mesophytes
 d. Halophytes
25. A group of interconnected food chains is called
 a. Pyramid of energy
 b. Complex food chain
 c. Food web
 d. Food cycle
26. Write botanical name of the most common plant yielding the following products
 (5 x 1 = 5)
 a. Menthol
 b. Nicotine
 c. Papain
 d. Taxol
- e. Vanillin
27. Answer the following :
 a. List two physiological functions of leghaemoglobin in N_2 fixation. (2)
 b. Name the precursor, intermediates and enzymes involved in ethylene biosynthesis pathway. (3)
28. Answer the following :
 a. How does shoot organogenesis differ from somatic embryogenesis? (2)
 b. In what ways are double haploids useful in breeding programme?
29. Answer the following :
 a. Diagrammatically represent cis and trans arrangements for two pairs (A and B are two dominant forms) of linked genes.
 b. What functions do telomere provide? (3)
30. Answer the following :
 a. Narrate the usefulness of reporter gene and selectable marker in plant transformation studies.
 b. Enumerate the role of *virA*, *virB* and *virD1* in T-DNA transfer.

M : MICROBIOLOGY

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 x 25 = 25)

1. Which of the statements given below on telomerase is incorrect?
 a. Telomerase is a ribonucleoprotein
 b. Telomerase can be defined as a reverse transcriptase
 c. It is an unusual DNA polymerase as it polymerises in 3' to 5' direction.
 d. It uses an RNA template to extend the ends of the chromosome
2. In order for an electron transport chain (EEC) to function
 a. Each component of the ETC should be capable of reduction by the reduced form of previous component and

- oxidized by the oxidized form of the downstream component
- Each component of the ETC should be capable of binding oxygen in its active site pocket
 - Each component should be capable of regulating the expression of downstream component
 - Genes of the components of ETC should be located on the same operon
- Electrode potential of hydrogen under physiological conditions is -0.42 V, and that of oxygen is $+0.82$. If the free energy change is defined by $\Delta G_{\text{O}^{\ominus}} = nF\Delta E_{\text{O}^{\ominus}}$, where $\Delta G_{\text{O}^{\ominus}}$ is the free energy change at pH 7.0; n is the number of electrons transferred, F is the Faraday constant (23000 cal/N), and $E_{\text{O}^{\ominus}}$ is the difference between the electrode potentials. What will be the free energy change upon reduction of oxygen by hydrogen to H_2O .
 - -57040 cal
 - $-28,520$ cal
 - $-23,000$ cal
 - $-104,080$ cal
 - While facing the minor groove of the right handed double stranded DNA, the left side DNA strand moves up in a
 - $3'$ to $5'$ direction
 - $5'$ to $3'$ direction
 - could be either $3'$ to $5'$ or the $5'$ to $3'$ direction
 - minor groove does not provide any idea to the direction of strand polarity
 - Several eubacterial mRNAs initiate protein synthesis from GUG codon. The initiating amino acid for the proteins encoded by such mRNAs is
 - Met
 - fMet
 - Val
 - fVal
 - Thermus thermophilus* is a
 - Gram negative eubacteria
 - Gram positive eubacteria
 - Gram negative archbacteria
 - Gram positive archbacteria
 - Deletion of a single nucleotide from the open reading frame sequence of a mRNA does not result in the following
 - a shorter polypeptide
 - an extended polypeptide
 - an altered N-terminal domain without affecting the C-terminal domain of the polypeptide
 - an altered C-terminal domain without affecting the N-terminal domain of the polypeptide
 - Of the following, which component is not required for protein synthesis in archbacteria?
 - Ribosomes
 - mRNA
 - release factors
 - fMet-tRNA
 - A mutant of *E. coli* which expressed lac operon constitutively may have a mutation in the following chromosomal locations,
 - lacI
 - lacO
 - lacI or lacO
 - lacZ
 - What will be the number of antibody specificities in an organism which has 200 V and 5 J genes for the light chain and, 300 V, 10 D and 5J genes for the heavy chain?
 - 520
 - 1000
 - 15,000,000
 - more than 15,000,000
 - Which of the following statements is correct?
 - CD8 binds to an invariant portion of MHC class II molecules
 - CD8 binds to an invariant portion of MHC class I molecules
 - CD8 binds directly to the peptide antigen
 - CD8 binds to the peptide binding site of MHC class I molecules
 - Which of the following disease is caused by DNA viruses?
 - Poliomyelitis
 - Yellow Fever
 - Measles
 - Small pox.
 - Which of the following disease is not caused by microbial protein toxin?
 - Botulism

- b. Diphtheria
c. Shigella dysentery
d. Tuberculosis.
14. Coxsackie virus B3, a subgroup of enteroviruses, commonly causes:
a. Acute hemorrhagic conjunctivitis
b. Muscular dystrophy
c. Myocarditis
d. Gastroenteritis.
15. Immunization with which of the following toxoid induces high the, serum antibody, but does not protect from the corresponding disease?
a. Tetanus
b. Botulism
c. Diphtheria
d. Shigellosis
16. All infections do not cause fever and all fevers are not due to infections; which of the following is an example of non-infectious cause of fever?
a. Typhoid
b. Chicken pox
c. Rheumatic disease
d. Malaria
17. Which of the following is a primary stain in acid fast staining of mycobacteria?
a. Crystal violet
b. Carbol fuchsin
c. Geimsa
d. Methylene blue
18. Antigenic peptides are presented to T-cells by
a. TCR/CD3
b. CD28
c. CTLA4
d. MHC
19. The nature of the poliovirus given for oral vaccination (Sabin vaccine) as part of the eradication program is:
a. Heat killed viruses
b. Live attenuated strains of all three immunological types.
c. Small dosage of wild-type live viruses,
d. Formalin-inactivated viruses
20. Which of the following statements on replication in *E. coli* is correct?
a. It occurs in a unidirectional manner
b. It occurs in bidirectional manner
c. Always uses T7 DNA polymerase when infected by T7 phage
d. Occurs only when λ phage has infected *E. coli*
21. Retting is a process of biodegradation used for,
a. Degrading retina from dead animals
b. Degrading pectin
c. Degrading cellulose
d. Degrading starch
22. Protosil is
a. an effective antibacterial when used in animals
b. an effective antibacterial when used in in vitro cultures
c. an effective antibacterial both in animals as well as in in vitro cultures
d. Protosil can not be used as an antibacterial agent
23. Subunit composition of histones in nucleosomes is:
a. (H1)(H2A)(H2B)(H3)(H4)
b. [(H1)(H2A)(H2B)(H3)(H4)]₂
c. H1[(H2A)(H2B)(H3)(H4)]₂
d. [(H2A)(H2B)(H3)(H4)]₂
24. Interval between completion of mitosis and beginning of DNA synthesis is called
a. G1 phase
b. G2 phase
c. S phase
d. M phase
25. During the progression of S-phase cdk2 is partnered by
a. cyclin A
b. cyclin D
c. cyclin E
d. transcription factor E2F
26. Answer the following :
a. Calculate the writhe of a covalently closed circular DNA with a linking number of 20 and topological winding number of 22. (2)
b. The chromatin in eukaryotes can exist as a 10 nm or a 30 nm fibre, what is a 10 nm fibre? (1)
c. What is the change in the packaging ratio when a 10 nm fibre is converted to a 30 nm fibre. (2)
27. Phage P1 lysate was raised on an *E. coli* strain (Tn10⁺, A⁻, B⁻, C⁻, D⁻) and used to

transduce a wild type strain of *E. coli*. The transductants were selected on a tetracycline plate and checked for their phenotypes. Following observations were made. All of the transductants were Tc^R . A : 80% were Tc^R, D^- ; 20% were Tc^R, B^- ; and 5% were Tc^R, C^- . None of the transductants were $Tc^R, A^+B^+C^+D^+$. Assuming that all the markers (A, B, C and D) are downstream of Tn 10, answer the following: (1+2+2)

- What is the order of A, B, C and D on the chromosome with respect to Tn10?
- Why do you think that none of the transductants was $Tc^R, A^+B^+C^+D^+$?
- In a reverse experiment, the P1 lysate was raised on Tc^R, C^- transductants and used to transduce a wild type strain of *E. coli*, what will be the likely frequency of obtaining Tc^R, A^- phenotype.

28. Of the several DNA polymerases in *E. coli*, DNA polymerase III plays a major role in DNA replication and it is responsible for the synthesis of both the leading strand and the Okazaki fragments in the lagging strand. However, the DNA polymerase I is also required during replication. Answer the following: (1+2+2)

- If the DNA polymerase III is mainly responsible for DNA replication, why is DNA polymerase I also needed during replication?
- While the DNA polymerase III is able to polymerase DNA on its own, it becomes highly processive in the presence of β -subunit, why?
- Can replication in *E. coli* chromosome begin at any place? If not, what is the exact site where replication begins?

29. Both the λ phage and M13 phage infect *E. coli*. Answer the following:

- λ phage results in the formation of clear plaque, whereas the plaques obtained upon M13 infection are turbid explain why? (2)
- How would you separate a mixture of mRNA, biotinylated-tRNA, and rRNA of eukaryotic origin? (3)

30. Match the name of the cellular processes listed in panel A with the specific inhibitors from panel B. (5)

Panel A:

- Translation in eukaryotes
- Glycosylation
- Transcription by RNA polymerase II
- Bacterial cell wall synthesis
- Apoptosis

Panel B:

- α -amanitin
- Cycloheximide
- Bel2
- Tunicamycin
- Penicillin

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

(1 x 25 = 25)

- Among the following phyla, one evolutionarily closest to the phylum chordata is
 - Annelida
 - Arthropoda
 - Echinodermata
 - Oncyphora
- The orders Anura, Urodela and Apoda belong to the class
 - Amphibia
 - Reptilia
 - Mammalia
 - Pisces
- Humans originated in the epoch known as
 - Pleistocene
 - Eocene
 - Holocene
 - Miocene
- The neotropic biogeographical region per terrestrial species is not bounded by the following biogeographical region is
 - Nearctic
 - Afrotropic
 - Antarctic
 - Indo-Malayan
- The condition albinism in man is linked to the deficiency of the enzyme

- a. Glucose-6-phosphate dehydrogenase
b. Arginase
c. Tyrosinase
d. Xanthin Oxidase
6. Of the following, identify the one which is not a stop codon
a. UAA
b. UAG
c. UGA
d. UAC
7. In a human cell, the number of moles of which one of the elements is the highest
a. Carbon
b. Oxygen
c. Nitrogen
d. Hydrogen
8. The body temperature of the following groups of animals occur in the order
a. Prototheria > Metatheria > Eutheria > Aves
b. Aves > Eutheria > Metatheria > Prototheria
c. Eutheria > Aves > Metatheria > Prototheria
d. Metatheria > Eutheria > Aves > Prototheria
9. The combination of closely linked genetic markers which tend to be transmitted as a unit to the next generation is called
a. Allotype
b. Haplotype
c. Karyotype
d. Isotype
10. The hormone epinephrine is involved in
a. Red blood cell synthesis
b. Stress response
c. Control of blood sugar level
d. Control of metabolic rate
11. Which of the following amongst the four is not a respiratory organ
a. Dorsal line
b. Trachea
c. Gills
d. Lungs
12. The hypervariable region of antibody molecule was first demonstrated by
a. Edelman and Porter
b. Kabat and Wu
c. Sastry and Pillai
d. Milstein and Kohler
13. The vector responsible for the spread of Filariasis is
a. Anopheles
b. Culex
c. Aedes
d. Sand fly
14. The following of the four is not a second messenger
a. ATP
b. Inositol 1,4,5 triphosphate
c. Ca^{++}
d. cAMP
15. Early pregnancy detection test detects the presence of which one of the following hormones
a. Human chorionic gonadotropin
b. Luteinizing hormone
c. Follicle stimulating hormone
d. Estrogen
16. Selective transfer of which one of the following antibodies is responsible for passive humoral immunity in infants
a. IgA
b. IgM
c. IgG
d. IgE
17. The animal that most recently became extinct is
a. Woolly mammoth
b. Giant moa
c. Dodo
d. Tasmanian wolf
18. The man who championed the theory of evolution of Darwin and often referred to as Darwin's bulldog is
a. Jullian Huxley
b. Aldous Huxley
c. T.H. Huxley
d. Andrew Huxley
19. If you were asked to clone a man from a single cell and you are provided with the following cells, which one you would choose
a. Sperm
b. Erythrocyte
c. Lymphocyte
d. Kidney fibroblasts

20. Community suckling of young ones is found in
 a. Cats
 b. Dogs
 c. Lions
 d. Humans
21. The number of complementarity determining region(s) present in human kappa chain are
 a. 1
 b. 2
 c. 3
 d. 4
22. Transfer RNA genes are transcribed by
 a. RNA polymerase I
 b. RNA polymerase II
 c. RNA polymerase III
 d. RNA dependent RNA polymerase
23. Shine-Dalgarno sequence is associated with
 a. Translation
 b. Transcription
 c. Replication
 d. Recombination
24. Gonadotropin releasing factor is synthesized by
 a. Anterior Pituitary
 b. Hypothalamus
 c. Adrenal gland
 d. Thymus
25. In eukaryotic cells, DNA synthesis occurs during the phase of the cell cycle
 a. G1
 b. G2
 c. M
 d. S
26. There are major scientific discoveries given in the column A and the names of the discoverers in the column B. Match the discovery with the discoverer. (1 x 5 = 5)
 Column A
 A. Base equivalence in DNA
 B. Human Genome Sequence
 C. PCR
 D. Prions
 E. Polio Vaccine
- Column B
 1. J.C.Venter
 2. F.Crick
 3. E.Chargaff
 4. J.Salk
 5. S.B.Pruisner
 6. K.D.Mullis
27. Describe the following in one or two sentences. (1 x 5 = 5)
 a. Proteasome
 b. Spliceosome
 c. Nucleosome
 d. Polysome
 e. Episome
28. Define the following : (1 x 5 = 5)
 a. Autogenic succession
 b. Climatic climax
 c. Allelomorphs
 d. Capacitation
 e. Linking number
29. Answer the following :
 a. What do you understand by homogametic sex? (1)
 b. Is human male is a homogametic sex? Give reason for your answer. (1)
 c. What is assortive mating? (1)
 d. What is gynendromorph? (1)
 e. What is codominance? (1)
30. Answer the following :
 a. What do you understand by Non-disjunction? (1)
 b. What is the genetic defect present in Down's syndrome? (1)
 c. What is co-evolution and what is its implication in host-parasite relationship? (2)
 d. What is a cline? (1)