BIO504 - BIOCHEMISTRY - I

ALL OBJECTIVEs & SUBJECTIVEs FROM PAST FILES FOR FINAL TERM

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OBJECTIVEs

1. The Tm of DNA is influenced by _____ **All Of Above**
2. Purine base found in RNA is_____ **Guanine**
3. Compounds that generate nitrous acid (such as nitrites, nitrates, and nitrosamines) change DNA molecules by: _____ _____ **Breakage Of Phosphodiester Bonds**
4. Under appropriate conditions DNA will form a hybrid with a complementary ____ **Both**
5. DNA model was presented by Watson and Crick in _____**1953**
6. Around structural core of the nucleosome. a segment of the DNA double helix is wound nearly twice - approximately _____ **140bp**
7. Adenosine 3'-phosphate-5'-phosphosulfate is the ---------- donor_____ **Sulphate**
8. A short length of DNA molecule has 80 thymine and 80 guanine bases. The total number of nucleotide in the DNA fragment is _____ **320**
9. Which of the following is a palindromic sequence? **GGATCC CCTAGG**
10. The complex folding of large chromosomes within eukaryotic chromatin and bacterial nucleoids is generally considered ____ **Tertiary Structure**
11. Higher GC base pairs increases Tm, because , with three hydrogen bonds, require-…. heat energy to dissociate than AT base pairs. ___ __ **More**
12. Chromatin is composed of _____ **Nucleic Acids And Protein**
13. The sugar molecule present in nucleotide is_____ **Pentose**
14. Eukaryotic DNA is associated with tightly bound basic …. called histones ___ **Proteins**
15. When DNA is heated, the temperature at which ------ of the helical structure is lost is defined as the melting temperature _____**One Half**
16. Z-DNA have a _____**Zig-Zag Appearance**
17. RNA duplexes are -…. stable than DNA duplexes _____ **More**
18. The ……. strand is called Template strand while____**3-5**
19. DNA replication is _____ **Semi-Conservative**
20. Nucleotides are composed of ___ **All**
21. Glucose residues in amylose are linked by ____. **α (1,4) linkage**
22. The number of carbon atoms in lysine is ____. **6**
23. If the carbonyl group is present at the end of the monosaccharide, then it is called __ **Aldose**
24. The number of stereoisomers for a molecule containing only one chiral carbon is ___ **2**
25. Seminal fluid is rich in ___. **Fructose**
26. Which of the following glycosidic linkage exists between two glucose units of maltose? ___**Alpha 1,4**
27. Amino sugar is formed by the replacement of the hydroxyl group at ----- of the parent monosaccharide with amino group. _____ **C-2**
28. Which one of the following is a structural homopolysaccharide? _____**Cellulose**
29. Which one of the following amino acids is not specified by three letter codons? **Selenocysteine**
30. Acid dissociation constants are designated as _____. **PKa**
31. 42. When linked to vitamins nucleotides are structural components of several essential coenzymes. For _____**Coenzyme A**

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32. The "energy carrier" ATP is an example of a(n): ____**Deoxyribonucleoside Triphosphate**
33. The - strand is called Template strand while _____ **3-5**
34. Nucleotides also serve as carriers of activated intermediates in the synthesis of ---- **All**
35. These bonds, plus the van der Waals and hydrophobic interactions between the adjacent stacked bases, stabilize the structure of the double helix ____ **Hydrogen**
36. Histones are ---- charged __ **Positively**
37. A phosphodiester r bond is present in _____ **Nucleic Acids In A Nucleotide**
38. Which one of the following is true of the pentoses found in nucleic acids? ___**The Pentoses Are Always In The Bita-Furanose Forms**
39. A DNA segment contains 100 Adenine and 100 cytosines, how many nucleotides are present in the segment? _____**400**
40. The DNA oligonucleotide abbreviated pATCGAC: ___ **Has A Hydroxyl At Its 3 Ends**
41. In living cells, nucleotides and their derivatives can serve as: ____**All Of The Above**
42. S-adenosylmethionine is a …. group donor ___ **Methyl**
43. Which one is example of coenzymes ____**All**
44. ATP is _____**Nucleotide**
45. There are ~ classes of histones ___**5**
46. Single-stranded DNA has … relative absorbance at 260nm wavelength than does double- stranded DNA ___ **Higher**
47. Separation of the two strands of the double helix when …… bonds between the paired bases are disrupted _ **Hydrogen**
48. Find the correct statement about phosphodiester linkage between adjacent nucleotides in nucleic acids_____**5'-Phosphate Of One Nucleotide Joins The 3- Hydroxyl Of The Next Nucleotide**
49. According to Chargaff's Rules which one is not correct __ **Guanine Equals The Amount Of Thymine**
50. Nucleosomes can be packed more tightly to form polynucleosome also called a nucleofilament or a ---nm fibre. __**30**
51. Nucleoside contains_____ **Base-Sugar**
52. The difference between thymine and uracil is: ___**One Methyl Group On The Pyrimidine Ring,**
53. In a double-stranded nucleic acid, cytosine typically base-pairs with: ____ **Guanine.**
54. Disruption of DNA can occur in the laboratory with alteration in ___ **All Of The Above**
55. Any regular. stable structure taken up by some or all of the nucleotides in a nucleic acid can be referred to as _____ **Secondary Structure**
56. Nucleic acids are a polymer of nucleotide monomeric units. Each nucleotide consists of _____ **Base~ Sugar -~Phosphate**
57. The DNA wrapped around the nucleosome core is continuous and joins one nucleosome core to the next -the linker DNA. This 50 bp DNA is complexed with the fifth type of histone, ---_____**H1**
58. The phosphodiester bonds that link adjacent nucleotides in both RNA and DNA: _____ **Form Between The Planar Rings Of Adjacent Bases**.
59. DNA that is not copied during the synthesis of mRNA is also called as _ **Non-Template**
60. Certain anticancer drugs. exert their cytotoxic effect by intercalating into the ------- groove of the DNA double helix, thus interfering with RNA and DNA synthesis ___ **Narrow**
61. The pI of glutamate is ___ **3.22**

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62. Which of the following amino acid is negatively charged at physiological pH? ___**Aspartate**
63. Which of the following refers to particularly stable arrangements of amino acid residues giving rise to recurring structural patterns? _____**Secondary Structure**
64. Keratin is present in ___. **All Of These**
65. Which of the following amino acid is involved in the hydrophobic interactions in the tertiary structure of protein? ___ **Phenylalanine**
66. The free energy of a protein molecule is influenced by ___ **All of These**
67. Which of the following diseases is caused by protein misfolding? ___**All Of These**
68. Iron is a _____. **Transition Metal**
69. Myoglobin can bind ____ molecules of oxygen. ____**One**
70. The partial pressure of oxygen (pO2) in lungs is about ____. **30 mmHg**
71. In sickle cell anaemia, Glutamate is replaced with ____. **Valine**
72. Oxy hemoglobin dissociation curve describes the relationship of --------- **Available Oxygen**
73. Which one of the following is made up of two molecules of glucose? ___ **Maltose**
74. Which bond exists between the carbonyl group and oxygen of a hydroxyl group in ring structure of glucose? ___**Covalent**
75. In Benedict test, the formation of cuprous oxide is indicated by the formation of ____. **Red ppt**
76. Glucose 6 Phosphate is formed by the addition of phosphate group to C6 of glucose by _ linkage. **Ester**
77. E. coli convert lactose of milk to lactic acid by action of ____. **Beta Galactosidase**
78. Proteins are denatured by __. **Temperature**, pH, **Organic Solvents**
79. About ____ of amino acid residues in the myoglobin are found in alpha helices. ___**78%**
80. Haemoglobin is found exclusively in ___. **Red Blood Cells**
81. The partial pressure of oxygen (pO2) in lungs is about ____. **30 mmHg**
82. In sickle cell anaemia, Glutamate is replaced with ____. **Alanine**

SUBJECTIVEs

1. Chargaff's Rules.

⇒ Due to specific base pairing of DNA i.e A toT and G to C
⇒ In any sample of double-stranded DNA the amount of adenine equals the amount of thymine.
⇒ The amount of guanine equals the amount of cytosine
⇒ The total amount of purines equals the total amount of pyrimidines ;
⇒ i.e. A + G = T+ C.
⇒ The base pairs are held together by hydrogen bonds
⇒ Two between A and T
⇒ Three between G and C
⇒ These hydrogen bonds, plus the van der Waals and hydrophobic interactions between the adjacent stacked bases, stabilize the structure of the double helix. The base composition of DNA varies from one

species to another, but is same if isolated from different tissues of same species. The base composition does not change with age, nutritional status and environment.

2. Types of Reversible Inhibitors.

The two most commonly encountered types of reversible inhibition are;

- competitive and
- noncompetitive.
- Competitive inhibitors resemble the substrate and compete for binding to the active site of the enzyme.
- Noncompetitive inhibitors do not bind at the active site. They bind either free enzyme at a site other than active site or the ES comcomple

3. Ribozymes

some RNA molecules have intrinsic catalytic activity these RNA enzymes are called ribozyme.

4. Condensation Reaction with Example

Chemical reaction which involves removal of a water molecule is called Condensation reaction.

- The N-glycosyl bond is formed by removal of the elements of water , a hydroxyl group from the pentose and hydrogen from the base,Thus it is a condensation reaction.
- Similar to O-glycosidic bond formation in carbohydrates.

5. Isozyme of hexokinase

The isozyme of hexokinase, called glucokinase, which is found in the liver has a much higher Km of approximately 5 to 6 mM- helpful in storing large amounts of “excess” glucose as glycogen or converting it to fat after a carbohydrate meal.

6. Reaction Velocity (v)

- The rate or velocity of a reaction (v) is the number of substrate molecules converted to product per unit time;
- Velocity is usually expressed as µmol of product formed per minute.
- The rate of an enzyme-catalyzed reaction increases with substrate concentration until a maximal velocity (Vmax) is reached- reflecting the saturation with substrate of all available binding sites are occupied on the enzyme molecules present. (Vmax) is reached- reflecting the saturation with substrate of all available binding sites are occupied on the enzyme molecules presen

7. Unsual or Modified Bases of RNA

- t RNA molecules consist of 74-95 nucleotides in a particular sequence.
- The t RNA molecules contain not only the usual bases like adenine, guanine, cytosine, uracil but also contain unusual bases
- These unusual bases(also called modified bases) include • Dihydrouracil • Pseudouridine
- Thymine.

8. Sorbitol:

- 35-60% sweetness of glucose.
- Used as an artificial sweetner

- Accumulates in tissues such as the eye lens in diabetes mellitus

9. What is the concentration of H+ in a solution of 0.1 M NaOH? Solution: Kw= $[H^+][OH^-]$

- With [OH-] = 0.1 M, solving for [H+] gives
- $[H^+] = Kw/[OH^-] = 1 \times 10\text{-}14M2/ 0.1M = 10\text{-}14M2/0.1M = 10\text{-}13M$

10. The Induced Fit Hypothesis

- Some proteins can change their shape (conformation)
- When a substrate combines with an enzyme, it induces a change in the enzyme'sconformation
- This change in conformation when the substrate binds is induced by multiple weak interactions with the substrate.
- There may also be rearrangements of covalent bonds during an enzyme-catalyzed reaction.
- This conformational change is referred to as induced fit.
- Chemical reactions of many types take place between substrates and enzyme's functional groups (specific amino acid side chains, metal ions, and coenzymes
- Induced fit serves to bring specific functional groups on the enzyme into the proper position to catalyze the reaction.

11. Induced Fit Theory

⇒ Enzyme is not rigid, changes shape with substrate.
⇒ The active site is also moulded into a precise conformation
⇒ Making the chemical environment suitable for the reaction

12. Properties of Nitrogenous Bases

Aromatic:

The Nitrogen containing bases are aromatic i.e. they have alternate double bonds

Heterocyclic:

- They are heterocyclic i.e. structures that contain other atoms in addition to carbon, such as nitrogen in the ring structure
- The six-atom rings of purines and pyrimidines are numbered in opposite directions.

Weak Bases:

Purines or pyrimidines with an –NH2 group are weak bases

Functional Groups:

The most important functional groups of pyrimidines and purines are

- ring nitrogens
- carbonyl groups
- exocyclic amino groups

Hydrophobicity:

⇒ The purine and pyrimidine bases are hydrophobic and relatively insoluble in water at the near-neutral cell pH
⇒ Stacking Interaction:

Hydrophobic stacking interactions in which two or more bases are positioned with the planes of their rings parallel (like a stack of coins) are one of two important modes of interaction between bases in nucleic acids.

Base stacking helps to minimize contact of the bases with water, and these interactions are very important in stabilizing the threedimensional structure of nucleic acids.

13. Simple lipids:

Esters of fatty acids with various alcohols These contain:

- Fats (and Oils) and
- Waxes.
- Fats: Esters of fatty acids with glycerol (Oils are fats in the liquid state)
- Waxes: Esters of fatty acids with higher molecular weight monohydric alcohols(having one OH group.

14. Properties of waxes

- Waxes are insoluble in water, but soluble in fat solvents and are negative for acrolein test. very resistant to rancidity.
- Waxes are not easily hydrolyzed as the fats and are indigestible by lipases (enzymes responsible for fat digestion in body)
- Thus they are of no nutritional value.

15. Order of Reaction

- When [S] is much less, then the velocity of the reaction is approximately proportional to the substrate concentration.
- The rate of reaction is then said to be first order with respect to substrate.
- When [S] is much greater than Km the velocity is constant and equal to Vmax.
- The rate of reaction is then independent of substrate concentration, and is said to be zero order with **respect to substrate concentration.**

16. Difference Between Thymine and Uracil

- Thymine is 2,4-dioxy-5-methyl-pyrimidine
- Uracil is 2,4dioxypyrimidinT and U differ by only one methyl group, which is present on T but absent on U.

17. Functions of c-AMP

- Acts as second messenger in the cell .
- It has role in glycogen metabolism, cAMP, glycogenolysis ,cAMP TAG metabolism, cAMP lipolysis .
- It decreases cholesterol synthesis
- It causes activation of protein kinases which in turn; activate or deactivate other enzymes.
- It regulates the cell membrane permeability, by increasing permeability of cellmembrane to H2O, Na +, K+& Ca +2
- Moreover, it regulates insulin secretion, catecholamine biosynthesis & Melatonin synthesis .
- Cyclic GMP is synthesized from GTP

⇒ It serves as a second messenger in response to nitric oxide during relaxation of smooth muscle (especially blood vessels) so it has role in smooth muscle relaxation and vasodilatation. It also has role in, Protein phosphorylation,Neurotransmission , Insulin action , Regulation of sodium channels

18. Cofactors, Coenzymes and Prosthetic groups

- Some enzymes require no chemical groups for activity other than their amino acid residues.
- Whereas some enzymes require molecules other than proteins for enzymic activity.
- If the non-protein moiety is a metal ion such as Zn2+ or Fe2+ , it is called a cofactor.
- If it is a complex organic molecule or metallo-organic compound it is termed a coenzyme.
- A coenzyme or metal ion that is very tightly or even covalently bound to the enzyme protein is called a prosthetic group.
- The term holoenzyme refers to the active enzyme with its nonprotein component, whereas the enzyme without its nonprotein moiety is termed an apoenzyme (apoprotein) and is inactive.
- Coenzymes serve as recyclable shuttles that transport many substrates from one point within the cell to another.
- The function of these shuttles is twofold.
- First, they stabilize species such as hydrogen atoms (FADH) or hydride ions (NADH) that are too reactive to persist for any significant time in the presence of the water or organic molecules that permeate cells.
- Second, they serve as an adaptor or handle that facilitates the
- recognition and binding of small chemical groups, such as acetate (coenzyme A) or glucose (UDP), by their target enzyme

19. Nucleotides as Carriers of intermediates:

Nucleotides also serve as carriers of activated intermediates in the synthesis of some carbohydrates, lipids, and proteins.

- The sugar derivatives UDP-glucose and UDP-galactose participate in sugar inter conversions And in the biosynthesis of starch and glycogen .
- Similarly, nucleoside-lipid derivatives such as CDP acylglycerol are intermediates in lipid biosynthesis.

20. Template and Non-template Strands

- The term template strand refers to the sequence of DNA that is copied during the synthesis of mRNA.
- The opposite strand is called the Non Template or coding strand or the mRNA-like strand it has base sequence directly corresponding to the mRNA sequence .
- the sequence corresponds to the codons that are translated into protein
- The 3´-5´strand is called Template strand while
- 5´-3´ strand is called Non Template (coding strand).

21. (cGMP) Functions

- serve as second messengers in signal transduction pathways. Signal Transduction: GTP and GDP play key roles in activating or inhibiting proteins in various cellular signaling cascades.
- Medical applications Specifically medical applications include the use of synthetic purine and pyrimidine analogs that contain halogens, thiols, or additional nitrogen atoms;
- There use include chemotherapy for cancer
- as suppressors of the immune response during organ transplantation.

- **as anti-viral drugs such as in the treatment of AIDS**

22. Michaelis-Menten equation, the rate equation

- Leonor Michaelis and Maud Menten in 1913, proposed a simple model that accounts for most of the features of enzymecatalyzed reactions.
- They postulated that the enzyme first combines reversibly with its substrate to form an enzyme-substrate complex in a relatively fast reversible step: k1 E + S ↔ ES K1
- The ES complex then breaks down in a slower second step to yield the free enzyme (E) and the reaction product (P): K2 ES ↔ E + P K-2
- Early in the reaction, the concentration of the product, [P], is negligible, and we make the simplifying assumption that the reverse reaction, P → S (described by k-2), can beignored.
- This assumption is not critical but it simplifies our task.
- The overall reaction then reduces to k1 K2 • E + S ↔ ES → E + P K-I k1 E + S ES—k2 →E + P k-1 E = Enzyme S = Substrate P = Product

23. Platelet-activating factor (PAF)

⇒ This is an unusual ether glycero phospholipid, with a saturated alkyl group in an ether link to carbon 1 and an acetyl residue (rather than a fatty acid) at carbon 2 of the glycerol backbone.
⇒ PAF is synthesized and released by a variety of cell types
⇒ It binds to surface receptors, triggering potent thrombotic and acute inflammatory events .
⇒ It causes platelets to aggregate and degranulate (required for clotting), and neutrophils and alveolar macrophages to generate superoxide radicals (required for microbial killing)

24. Effect of pH on the ionization of the active site:

⇒ The concentration of H+ affects reaction velocity in several ways.
⇒ First, the catalytic process usually requires that the enzyme and substrate have specific chemical groups in either an ionized or un-ionized state in order to interact.
⇒ For example, catalytic activity may require that an amino group of the enzyme be in the protonated form (–NH3 +).
⇒ At alkaline pH, this group is deprotonated, and the rate of the reaction, therefore, declines.
⇒ Extremes of pH can also lead to denaturation of the enzyme.

25. Small Km VS large Km

Small Km: A numerically small (low) Km reflects a high affinity of the enzyme for substrate, because a low concentration of substrate is needed to half-saturate the enzyme—that is, to reach a velocity that is 1⁄2 Vmax

Large Km: A numerically large (high) Km reflects a low affinity of enzyme for substrate because a high concentration of substrate is needed to halfsaturate the enzyme

The velocity of an enzyme is most sensitive to changes in substrate concentration over a concentration range below its Km. d. At substrate concentrations less than 1⁄10th of the Km, a doubling of substrate concentration nearly doubles the velocity of the reaction . At substrate concentrations 10 times the Km, doubling the substrate concentration has little effect on the velocity.

26. Hydrogenation with Respect to Fats

converts Unsaturated fatty acids to Saturated fatty acids.

Margarines are vegetable oils treated with partial hydrogenation to form semi- solid consistency 'butter'

- Hydrogenated fats are used by many commercial food producers to Provide rich texture , Increase shelf live , Increase melting point .
- Resistance to oxidation and flavour deterioration
- Partial hydrogenation has an undesirable, effect: some cis double bonds are converted to trans double bonds.
- There is a strong evidence that dietary intake of trans fatty acids
- (often referred to as "trans fats") leads to a higher incidence of cardiovascular disease, therefore these fats should be avoided in the diet.

27. Iodine Number

The degree of unsaturation is reflected by Iodine number.

⇒ Iodine number is defined as the number of grams of iodine absorbed by 100 gm of fat.
⇒ The more the iodine number, the greater the degree of unsaturation.
⇒ Fats rich in saturated fatty acids have low iodine numbers,
⇒ while fats rich in unsaturated fatty acids have high iodine numbers
⇒ The determination of iodine number is useful to the chemist in determining the quality of an oil or its freedom from adulteration
⇒ Iodine number of cotton seed oil varies from 103 to 111.
⇒ That of olive oil from 79 to 88,
⇒ And that of linseed oil from 175 to 202
⇒ A commercial lot of olive oil which has iodine number higher than 88 might have been adulterated with cotton seed oil
⇒ The higher is the iodine number, the more reactive, less stable, more susceptible to oxidation and rancidification is the oil or fat.

28. Characteristics of Palmitic Acid

- Other Fatty acids commonly found in body which are worth knowing are:
- Palmitic Acid (16:0)
- Stearic Acid (18:0) and Oleic acid (18:1)
- Palmitic Acid(16:0) Palmitic acid, or hexadecanoic acid, is the
- most common saturated Fatty Acid found in animals, plants and microorganisms
- Palmitic acid mainly occurs as its ester in triglycerides (fats), especially palm oil.
- It is also found in high amounts in Butter, Cheese, milk and meat
- Excess carbohydrates in the body are converted to palmitic acid.
- Palmitic acid is the first fatty acid produced during fatty acid synthesis and the precursor to longer fatty acids
- As a consequence, palmitic acid is a major body component of fats found in the animals.

29. Pathway of Arachidonic Acid Metabolism

Arachidonic acid is the most common precursor of the eicosanoids.

- Three major pathways for the metabolism of arachidonic have been discovered so far.
- Cyclooxygenase pathway; prostaglandins and thromboxanes.
- lipoxygenase pathway; leukotrienes, HETEs, and lipoxins.
- cytochrome P450 pathway epoxides and HETEs
- There are different series of eicosanoids
- depending on the precursor 20 C FA. derived from the essential fatty acids linoleic acid and linolenic, OR directly from dietary arachidonic acid and eicosapentaenoic acid
- Depending on the precursor different numbers of double bonds are present in these eicosanoids reflecting the parent 20C FA.

30. Nucleotides as Energy Currency of the cell

Nucleotides play an important role as "energy currency" in the cell.

- Nucleoside tri- and diphosphates such as ATP and ADP are the principal donors and acceptors of phosphoryl group in metabolism.
- By doing this, they play a key role in the energy transduction.

This energy is used in almost every energy requiring process in the body, such as; Muscle contraction, Transmission of nerve impulse, Transports of nutrients across cell membrane Motility of spermatozoa And many more energy dependent processes

31. Nucleotides Composition

Nucleotides Composition are composed of

- A nitrogenous base (purine or pyrimidine)
- A pentose monosaccharide
- One, two, or three phosphate groups

32. Rancidity

- The chemical deterioration of fats.
- When lipid-rich foods are exposed too long to the oxygen in air, they may spoil and become foul smelling.
- It is a physico-chemical change in the natural properties of the fat leading to the development of unpleasant odor or taste or abnormal color .
- It occurs particularly on aging after exposure to atmospheric oxygen, light, moisture, bacterial or fungal contamination and/or heat.
- Saturated fats resist rancidity more than unsaturated fats that have unsaturated double bonds.

33. Difference between Oxidative and Hydrolytic Rancidity

Rancidity is due to Oxidation and Hydrolysis

Oxidative Rancidity

- Oxidation of the fat molecules give rise to some short
- chain aldehydes, ketones and dicarboxylic acids which have objectionable taste and odor.

- The unpleasant taste and smell associated with rancidity result from the oxidative cleavage of double bonds in unsaturated fatty acids .
- The oxygen of the air is necessary for this type of rancidity. This can be prevented by addition of anti-oxidants such as vitamin E to foods.

Hydrolytic Rancidity

It is due to the slow hydrolysis of fats, which in case of fats like butter results in the liberation of short chain fatty acids which are volatile and have rancid taste and odor.

34. DNA Renaturation /Intact Duplex

Under appropriate conditions (temp. & salt concentration), separated strands of DNAwill renature or reassociate and form the double helix by the process called renaturation (or reannealing). This reannealing process is also referred to as hybridization. When the temperature or pH is returned to the range in which most organisms live, the unwound segments of the two strands spontaneously rewind, or anneal, to yield the intact duplex

35. Cyclic Nucleotides

There are two important cyclic nucleotides:

- Cyclic AMP cAMP
- Cyclic GMP cGMP

- Cyclic AMP is a cyclic nucleotide
- cAMP is synthesized in tissues from ATP
- chemically it is 3´-5´ adenosine monopohosphate.

36. Functional Groups in Nucleotides

The most important functional groups of pyrimidines and purines are

- ring nitrogens
- carbonyl groups
- exocyclic amino groups

37. Oxidoreductases Enzyme and it's Subgroups

- catalyze oxidation reduction reactions, further divided into four subgroups;
- Oxidase,
- Dehydrogenases,
- Hydroperoxidases
- Oxygenases.

38. Lipoproteins Names/few examples

LDL,VLDL,HDL

39. VLDLs

VLDLs (very low density lipo proteins) are assembled in the liver.

- composed predominantly of TAGs synthesized in liver and

- contain some cholesterol and cholesteryl esters
- As VLDL pass through the circulation, TAG is degraded and taken up by peripheral tissues in the form of fatty acids, causing the VLDL to decrease in size and become denser, called VLDL remnant.

40. Sterols

Steroids with eight to ten carbon atoms in the side chain at C-17 and a hydroxyl group at C-3 are classified as sterols. phospholipids and sterols are the major structural elements of biological membranes.

41. Xanthine oxidase

Xanthine oxidase is a form of xanthine oxidoreductase, a type of enzyme that generates reactive oxygen species. These enzymes catalyze the oxidation of hypoxanthine to xanthine and can further catalyze the oxidation of xanthine to uric acid

42. Contractile Proteins:

These proteins are involved in muscle contraction and relaxation

⇒ Myosin of thick filaments
⇒ Actin of thin filaments of skeletal muscles

43. How is light Produced in Fire Flies

The light produced by fireflies is the result of a reaction involving the protein luciferin and ATP, catalyzed by the enzyme luciferase

44. Unnatural Pyramidine Bases:

⇒ Fluorouracil (5FU) & 6-Aza Cytosine (AZC)
⇒ Unlike the purine ring, which is not cleaved in human cells, the pyrimidine ring is opened and degraded to highly soluble products, β-alanine and βamino-iso-butyrate, with the production of NH3 and CO2.

45. TAGs or Storage Lipids

Triacylglycerols (TAGs)

- The simplest lipids constructed from fatty acids are the triacylglycerols, Also referred to as; triglycerides, fats, or neutral fats or storage lipids.
- Triacylglycerols are composed of three fatty acids in ester linkage with a single glycerol

46. Functions of c-AMP

- Acts as second messenger in the cell
- It has role in glycogen metabolism
- cAMP, glycogenolysis
- cAMP TAG metabolism
- cAMP lipolysis
- It decreases cholesterol synthesis
- It causes activation of protein kinases which in turn;
- activate or deactivate other enzymes.

- It regulates the cell membrane permeability, by increasing permeability of cell membrane to H2O, Na +, K+& Ca +2 .
- Moreover, it regulates insulin secretion, catecholamine biosynthesis & Melatonin synthesis
- Cyclic GMP is synthesized from GTP
- It serves as a second messenger in response to nitric oxide during relaxation of smooth muscle (especially blood vessels) so it has role in smooth muscle relaxation and vasodilatation.
- It also has role in Protein phosphorylation ,Neurotransmission , Insulin action , Regulation of sodium channels

47. Classification of Enzymes

❖ Oxidoreductases

Catalyze oxidation reduction reactions, further divided into four subgroups;

- Oxidase,
- Dehydrogenases,
- Hydroperoxidases
- Oxygenases.

❖ Transferases

These bring about a transfer of functional groups such as

- phosphate and
- amino group
- from one molecule to another molecule called donor and acceptor molecules respectively.
- The common examples of this group are
- Transminases
- Phosphotransfrases (Kinases)
- Hexokinase is a phosphotransfease which catalyze the transfer of phosphate groups.
- Glucose + ATP → Glucose 6-phosphate + ADP.

❖ Hydrolases

These enzymes catalyze hydrolysis, i.e.

- add water molecule to the substrate which is simultaneously decomposed; the functional group of substrate is transferred to water.
- Common example of hydrolases are:
- Protein hydrolyzing Enzymes (peptidases).
- Carbohydrases
- Lipid hydrolyzing enzymes e.g. Lipases and

❖ Lyases

Theses enzymes catalyze the addition of NH_3, H_2O or CO_2 to double bonds or the removal of these groups leaving behind double bonds. Lyases are included in a separate class because they catalyze these reactions by means other than hydrolysis or oxidation.

❖ Isomerases

These enzymes catalyze the structural change within a single molecule by the transfer of groups within it, resulting in the formation of an isomeric form of substrate.

❖ **Ligases**

These enzymes catalyze condensation reactions joining two molecules by forming

- C-O,
- C-S,
- C-N and
- C-C bonds.
- The energy for condensation is provided by cleavage of high energy phosphates, e.g. ATP, GTP etc.

48. Nucleotides In Signal Transduction Pathway

- Second messengers: Nucleotides, such as cyclic AMP (cAMP) and cyclic GMP (cGMP), serve as second messengers in signal transduction pathways. DP play key roles in activating or inhibiting proteins in various cellular signaling cascades.
- Medical applications Specifically medical applications include the use of synthetic purine and pyrimidine analogs that contain halogens, thiols, or additional nitrogen atoms;
- There use include chemotherapy for cancer
- as suppressors of the immune response during organ transplantation.
- as anti-viral drugs such as in the treatment of AIDS 168 Nucleotides and Nucleic Acids-Numbering of Carbon and Nitrogen Atoms

49. Numbering of Carbon and Nitrogen Atoms

⇒ The carbon and nitrogen atoms in the rings of the base and the sugar are numbered separately
⇒ The atoms in the rings of the bases are numbered
⇒ 1 to 6 in pyrimidines &
⇒ 1 to 9 in purines
⇒ In the pentoses of nucleotides and nucleosides the carbon numbers are given a prime (') designation to distinguish them from the numbered atoms of the nitrogenous base.
⇒ The carbons in the pentose are numbered 1' to 5 '.
⇒ Numerals with a prime (e.g., 2' or 3') distinguish atoms of the sugar from those of the heterocycle.

50. Iodine Number

The number of grams of iodine which will be absorbed by 100 grams of a fat is termed its iodine number. Halogens such as chlorine, bromine and iodine can also be added to double bonds in unsaturated fatty acids. Degree of halogenation is a good index of degree of unsaturation of Fatty Acids

51. Hydrogenation with Respect to fats

- A hydrogenation reaction involves conversion of a carboncarbon double bond to a carboncarbon single bond through the addition of hydrogen Hydrogenation – As you continue to hydrogenate your molecule Melting point increases
- Fat becomes more solid at room temp
- Hydrogenation
- Oils which are liquid at ordinary room temperature,hydrogenation become solidified

- This is the basis of Banaspti ghee manufacturing.
- Where inedible and cheap oils like cotton seed oil are hydrogenated and converted to edible solid fats.
- The hydrogenation is done under high pressure of hydrogen and is catalyzed by finely divided nickel or copper and heat.
- It is the base of hardening of oils (margarine manufacturing), e.g.
- change of oleic acid of fats (liquid) into stearic acid (solid).
- unsaturated fats have lower melting points,stearic (SFA) melts at 70

52. Role of Nucleotides as Carriers of intermediates and CoEnzymes

Nucleotides also serve as carriers of activated intermediates in the synthesis of some carbohydrates, lipids, and proteins.

- The sugar derivatives UDP-glucose and UDP-galactose participate in sugar inter conversions And in the biosynthesis of starch and glycogen .
- Similarly, nucleoside-lipid derivatives such as CDP acylglycerol are intermediates in lipid biosynthesis.

Co-enzymes:

- When linked to vitamins nucleotides are structural components of several essential coenzymes, for example,
- coenzyme A,
- FAD, (Flavin Adenine Dinucleotide)
- Co-enzymes:
- NAD+ (Nicotinamide adenine Dinucleotide) and
- NADP+ (Nicotinamide adenine Dinucleotide Phosphate)
- Regulatory compounds: Nucleotides are important regulatory compounds for many of the pathways of intermediary metabolism, inhibiting or activating key enzymes.
- Roles that nucleotides perform in metabolic regulation include:
- ATP-dependent enzyme phosphorylation in key metabolic reactions.
- Allosteric regulation of enzymes by ATP, AMP, and CTP

53. Buffers

Buffers are aqueous systems that tend to resist changes in pH when small amounts of acid (H+) or base (OH-) are added

- A buffer system consists of a weak acid (the proton donor) and its conjugate base (the proton acceptor)
- As an example, a mixture of ;acetic acid and acetate ion, is a buffer system,
- If more H+is added to this solution, it simply shifts the equilibrium to the left, absorbing H+, so the [H+] remains unchanged.
- If H+is removed (e.g. by adding OH-) then the equilibrium shifts to the right, releasing H+to keep the pH constant .
- Notice that the titration curve of acetic acid has a relatively flat zone

54. Glycerol Trinitrate

Glycerol combines with three molecules of nitric acid to form Glycerol trinitrate that is used as explosive and vasodilator

- On esterification with fatty acids it gives:
- monoacylglycerol: one fatty acid + glycerol.
- diacylglycerol: two fatty acids + glycerol.
- triacyl-glycerol: three fatty acids + glycerol.

55. Halogenation with Respect to Fats

- Similar to hydrogenation,
- Halogens such as chlorine, bromine and iodine can also be added to double bonds in unsaturated fatty acids.
- It is a very important property to determine the degree of unsaturation of the fat or oil that determines its biological value.
- The degree of unsaturation is reflected by Iodine number.
- Iodine number is defined as the number of grams of iodine absorbed by 100 gm of fat.
- The more the iodine number, the greater the degree of unsaturation.
- Fats rich in saturated fatty acids have low iodine numbers,
- while fats rich in unsaturated fatty acids have high iodine numbers
- The determination of iodine number is useful to the chemist in determining the quality of an oil or its freedom from adulteration
- Iodine number of cotton seed oil varies from 103 to 111.
- That of olive oil from 79 to 88,
- And that of linseed oil from 175 to 202
- A commercial lot of olive oil which has iodine number higher than 88 might have been adulterated with cotton seed oil
- The higher is the iodine number, the more reactive, less stable, more susceptible to oxidation and rancidification is the oil or fat.

56. Disulphide Bridges

Disulfide bridges are sometimes called disulfide bonds or S-S bonds. They are covalent links between the Sulphur atoms of two cysteine amino acids and their formation stabilizes the tertiary and higher order structure of proteins.

57. Saponification /Saponification number

- Hydrolysis of a fat by an alkali is called saponification
- The resultant products are;
- glycerol and the alkali salts of the fatty acids, which are called “soaps”
- The number of mgs of NaOH/KOH required to saponify the free and combined FA in one gram of a given fat is called its saponification number.

The amount of alkali needed to saponify a given quantity of fat will depend upon the number of carboxylic (–COOH) group present .

Thus fats containing short chain fatty acids will have more – COOH groups per gram than long- chain fatty acids and this will take up more alkali And hence will have higher saponification number

58. Physical properties of TAGs /Neutral fats

- Neutral fats are colourless, odorless and tasteless substances
- Solubility:
- They are insoluble in water but soluble in organic fat solvents(e.g., ether, benzene, acetone, chloroform)
- Specific gravity:
- The specific gravity of all fats is less than 1.0, consequently all fats float in water
- Emulsification:
- Emulsions of fat may be made by shaking vigorously in water and by emulsifying agents such as gums and soaps
- The emulsification of dietary fats in intestinal canal, brought about by bile salts, is a prerequisite for digestion and absorption of fats.
- The bile salts, act to break apart the fat globules in the small intestines and allow them to become more "soluble" for absorption.
- The hydrophobic fat molecules will clump together into globules in the watery mixture in the digestive system.
- The emulsifiers break them down to smaller "globules" and allow them to become more soluble.

59. Calculate the ratio of the concentrations of acetate and acetic acid required in a buffer system of pH 5.30 (pKa = 4.76)

pH= pKa + log [acetate]/[acetic acid]
log [acetate]/[acetic acid]= pH- pKa = 5.30-4.76 = 0.54
[acetate]/[acetic acid] = antilog 0.54 = 3.5

60. Histone and it's Classes

Eukaryotic DNA is associated with tightly bound basic proteins, called histones.

- These serve to order the DNA into fundamental structural units, called nucleosomes. There are five classes of histones, designated H1, H2A, H2B, H3, and H4.
- These are positively charged at physiologic pH as a result of their high content of lysine and arginine.
- Two molecules each of H2A, H2B, H3, and H4 form the structural core of the nucleosome.
- Around this core, a segment of the DNA double helix is wound nearly twice approximately 140bp .
- The DNA wrapped around the nucleosome core is continuous and joins one nucleosome core to the next -the linker DNA
- this 50 bp DNA is complexed with the fifth type of histone, H1.
- Nucleosomes can be packed more tightly to form a polynucleosome also called a nucleofilament or a 30-nm fiber.
- The fiber is organized into loops that are anchored by nuclear scaffolding proteins. Additional levels of organization lead to the final chromosomal structure

61. SPHINGOLIPIDS and it's SubClasses

There are two subclasses of sphingolipids:

- **Sphingomyelins**
- **Sphingoglycolipids**
- Sphingomyelins contain phosphocholine or phosphoethanolamines as their polar head group and are therefore classified along with glycerophospholipids as phospholipids

- Sphingoglycolipids are molecules that contain both carbohydrate and lipid (in the form of ceramide) components

  When the alcohol group at carbon 1 of sphingosine is, esterified to phosphorylcholine, sphingomyelin, the only significant sphingophospholipid in humans, is produced

- Sphingomyelins are present in the plasma membranes of animal cells and are especially prominent in nerve tissue including myelin, -thus the name "sphingomyelins .
- Sphingomyelin of the myelin sheath contains predominant longer-chain fatty acids such as lignoceric acid and nervonic acid (24 carbon)
- whereas gray matter of the brain has sphingomyelin that contains primarily stearic acid(18 carbon)

62. Heterogenous mRNA

Unlike prokaryotic mRNA, eukaryotic mRNAs are monocistronic. The primary transcript in eukaryotes is much larger than the mature mRNA and is called Heterogeneous nuclear RNA (hnRNA). It contains unique sequences and has about 10 times as many sequences as the mature mRNA.

63. Acrolein Test

- On heating with sulfuric acid or KHSO4 (dehydration)
- it gives acrolein that has a bad odor.
- used for detection of free glycerol or any compound containing glycerol.
- In contrast to glycerol , Sphingosine does not show positive acrolein test.
- Therefore glycerolipids and shingolipids can be differentiated on the basis of acrolein test.

64. Difference between Co factor and Co Enzyme

Cofactors are chemical compounds that are bound to proteins. A cofactor is a non-protein chemical compound, while a coenzyme is a non-protein molecule. A specific type of cofactor, coenzymes, are organic molecules that bind to enzymes and help them function.

65. Lipoxins Formation and Function

The lipoxins are formed through the action of 15-lipoxygenase followed by the action of 5-lipoxygenase on arachidonic acid.

⇒ A series of reductions of the resultant hydro-per-oxy groups leads to the formation of tri-hydroxy derivatives of arachidonic acid known as the lipoxins.

⇒ Lipoxins induce chemotaxis and stimulate superoxide radicals for killing of microorganisms

⇒ Prostaglandins, thromboxanes, leukotrienes and lipoxins have very short half lives and rapidly degraded in the body.

⇒ In summary, Eicosanoids are derived from C20 (eicosanoic) fatty acids synthesized from the essential fatty acids and make up important groups of physiologically active compounds.

66. Calculate the pKa of lactic acid, given that when the concentration of lactic acid is 0.01M and the concentration of lactate is 0.087 M, the pH is 4.80

- pH= pKa + log [lactate]/[lactic acid]
- pKa = pH- log [lactate]/[lactic acid]

= 4.80 - log 0.087/0.01
= 4.80 - log 8.7
= 4.80 - 0.94
= 3.9

67. The Henderson-Hassebalch (HH) Equation

- The HH equation relates pH, pka, and buffer concentration This equation is simply a useful way of restating the expression for the ionization constant of an acid .
- For the ionization of a weak acid HA, the HH equation can be derived as follows:
- Ka = [H+][A-]/[HA]
- First solve for [H+]: [H+] = ka[HA]/[A-]
- Then take the negative logarithm of both sides:
- -log[H+] = -logka - log[HA]/[A-]
- Substitute pH for -log [H+] and pKa for -log Ka pH = pka – log[HA]/[A-]
- Now invert -log [HA]/[A-], pH = pka + log[A-]/[HA]
- This equation shows why the pKa of a weak acid is equal to the pH of the solution at the midpoint of its titration
- At that point, [HA]= [A-]
- pH = pka + log[A-]/[HA]
- pH = pka + log 1
- pH = pKa + 0
- pH = pk 66

68. pO2 atAltitude

At high altitude of hills and mountains, where the pO2 is considerably lower (due to low atmospheric pressure).

- The delivery of oxygen to the tissues is now reduced.
- However, after just a few hours at the higher altitude, the BPG concentration in the blood begins to rise, leading to a decrease in the affinity of hemoglobin for oxygen.
- This adjustment in the BPG level has only a small effect on the binding of oxygen in the lungs .
- But a considerable effect on the release of oxygen in the tissues shown by increased oxygen unloading at the peripheral tissues.
- Increase in BPG concentration in the RBC shifts the dissociation curve to the right, i.e. increased O2 unloading.
- BPG concentration also increases in those conditions in which there is decreased O2delivery to tissues, such as in anemia and respiratory diseases.
- As a result, the delivery of oxygen to the tissues is restored to nearly 40% of the oxygen that can be transported by the blood.

69. DNA /Nucleic Acids Interactions

Hydrophobic stacking interactions in which two or more bases are positioned with the planes of their rings parallel (like a stack of coins) are one of two important modes of interaction between bases in nucleic acids.

Base stacking helps to minimize contact of the bases with water, and these interactions are very important in stabilizing the threedimensional structure of nucleic acids.

70. Messenger RNA (mRNA)

This class is the most heterogeneous in

- Abundance Size (500-6000 nucleotides)
- base sequence
- Stability
- mRNA comprise about 2–5% of total cellular RNA
- mRNA molecules are formed with the help of DNA template strand (3´-5´) during the process called transcription.
- In addition to the protein coding regions in the mature eukaryotic mRNA that can be translated,
- there are untranslated regions at its 5´ and 3´ ends
- Moreover, there is a 5´ cap and a poly A tail at 3´ end
- Function of mRNA
- The members of this class function as messengers to convey the information in a gene to the protein synthesizing machinery.
- The mRNA carries genetic information from the nuclear DNA to the cytosol, where it is used as a template for protein synthesis.

71. Transfer RNA (tRNA)

- t RNA is the smallest of the three major species of RNA (4S).
- They are single stranded globular molecules.
- They remain largely in cytoplasm.
- They are generated by nuclear processing of a precursor molecule.
- tRNAs compose roughly 20% of total cellular RNA There are at least 20 species of tRNA molecules in every cell.
- Although each specific tRNA differs from the others in its sequence of nucleotides, the tRNA molecules as a class have many features in common
- Primary structure
- t RNA molecules consist of 74-95 nucleotides in a particular sequence.
- The t RNA molecules contain not only the usual bases like adenine, guanine, cytosine, uracil but also contain unusual bases
- These unusual bases(also called modified bases) include
- Dihydrouracil Pseudouridine
- Arms or loops of tRNA
- All tRNA molecules contain 4 main arms or loops.
- 1-Acceptor arm: This is made up of unpaired sequences of cytosine-cytosineadenine (CCA) at the 3´end.
- The 3´OH group of adenine binds with the carboxylic group of a specific amino acid and carries it to ribosomes for protein synthesis.
- 2-Anticodon arm: It is in the form of a loop and carries specific sequences of three bases which constitute the anticodon.
- The bases of anticodon are bonded with three complementary bases of codon on mRNA.

- Function of tRNA
- The t RNA molecules serve as ADAPTERS for the translation of information in the sequence of nucleotides of the mRNA into specific amino acids.
- There is at least one (and often several) specific type of tRNA molecule for each of the amino acids commonly found in proteins.
- Each t RNA carries its specific amino acid to the site of protein synthesis.
- There it recognizes the genetic code word on mRNA (codon) and this specifies the addition of its amino acids to the growing peptide chain.

72. Ribosomal RNA (rRNA)

- found in association with several proteins as a component of ribosomes--- a cytoplasmic nucleoprotein structure that acts as the machinery for the synthesis of proteins from the mRNA template.
- RNAs make up 80% of the total RNA in the cell.
- The ribosomal subunits are defined according to their sedimentation velocity in Svedberg units.
- Svedberg unit is related to the molecular weight and shape of the compound.
- The bases in r RNA are mainly adenine, guanine, cytosine and uracil and a few pseudouridine
- Eukaryotic Ribosome
- The mammalian ribosome contains two major nucleoprotein subunits:
- a larger one with 60S a smaller one with 40S.
- The 60S subunit contains
- a 5S rRNA
- a 5.8S rRNA
- a 28S rRNA
- more than 50 specific polypeptides.
- The 40S subunit is smaller and contains a single 18S rRNA
- Approx. 30 distinct polypeptide chains.
- In eukaryotes, all of the ribosomal RNA molecules except the 5S rRNA, which is independently transcribed, are processed from a single 45S precursor RNA molecule in the nucleolus- packed with the specific ribosomal proteins.
- The rRNA are necessary for ribosomal assembly and play a key role in the binding of mRNA to ribosomes and its translation
- In the cytoplasm, the ribosomes remain quite stable and capable of many translation Cycles

73. Other types of RNA Small nuclear RNA (snRNA)

Small nuclear RNA (snRNA) are large number of small stable RNA species found in eukaryotic cells.

- Most of them are complexed with proteins to form ribonucleoproteins. They are distributed in the nucleus, in the cytoplasm or in both.
- They are significantly involved in rRNA and mRNA processing and gene regulation.
- Large & Small Noncoding Regulatory RNAs
- One of the most exciting discoveries in the last decade of eukaryotic regulatory biology has been the identification and characterization of regulatory nonprotein coding RNAs (ncRNAs).
- NcRNAs exist in two general size classes,
- small consisting of microRNA (miRNAs) and silencing (siRNAs) and
- Large consisting of long noncoding RNAs (lncRNAs)

- The small ncRNAs termed microRNA (miRNAs) and silencing (siRNAs) typically inhibit gene expression at the level of specific protein production by
- targeting mRNAs through one of several distinct mechanisms.
- Both siRNAs and miRNAs typically hybridize, via the formation of RNA–RNA hybridization to their targeted mRNAs • long noncoding RNAs (lncRNAs).
- LncRNAs, which as their name implies, do not code for protein (ie, the mRNA encoding genes).
- ncRNAs make up a significant portion of eukaryotic transcription
- ncRNAs play many roles ranging from contributing to structural aspects of chromatin to regulation of mRNA gene transcription by RNA polymerase II.

74. PUFAs

The family of polyunsaturated fatty acids (PUFAs) with a double bond between the third and fourth carbon from the methyl end of the chain are of special importance in human nutrition

- Arachidonic acid 20:4Δ5,8,11,14 is referred to as an ω-6 fatty acid because the closest double bond to the ω end begins six carbons from that end.
- The essential fatty acid linoliec acid, 18:2 Δ9, 12 is ω-6 fatty acid.
- In contrast, α-linolenic acid, 18:3Δ9, 12, 15 is an ω-3 fatty acid

75. Eicosanoids

- Eicosanoids are a large group of lipid messengers with potent effects on every tissue in the body
- Eicosanoids are derived from metabolism of 20-carbon, polyunsaturated fatty acids (eicosanoic acids) .
- Eicosanoids include (but not limited to)
- Prostanoids consisting of
- Prostaglandins
- Prostacyclins
- Thromboxanes, 1. Leukotrienes, 2. Lipoxins, 3. Epoxides
- These extremely potent compounds acting through their specific receptors
- elicit a wide range of physiologic and pathologic responses.
- particularly important in eliciting inflammatory response that occurs after infection or injury an produce symptoms such as pain, swelling, and fever.
- they also control bleeding through forming blood clots
- Eicosanoids are derived from either omega-3 (ω-3) or omega-6 (ω-6) fatty acids.
- Arachidonic acid is the most common precursor of the eicosanoids.
- Three major pathways for the metabolism of arachidonic have been discovered so far.

جس نے علم حاصل کیا اور عمل نہ کیا وہ اس آدمی کی مانند ہے جس نے ہل چلایا اور بیج نہ بکھیرا۔

شیخ سعدیؒ