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BIO-202-Biochemistry-I FINAL TERM PAPER

1. Name two second messenger of nucleotides? (2marks)

Second messengers: Nucleotides, such as

1. Cycloadenosine mono phosphate(**cAMP**)
2. Cyclic Guanosine mono phosphate(**cGMP**)

2)What are simple lipids? give two types of simple lipids. (2 marks)

A simple lipid is a fatty acids of different type of alcohol and carry no other substances . A simple lipid is belong to the heterogeneous class of predominantly non polar in nature. They are insoluble in water but soluble in organic solvent, such as chloroform and benzene.

Simple Lipids: Fatty acids ester of different alcohol.

Fats: Fatty acid ester of different glycerol. Oil and fats are in liquid state. They are insoluble in water but soluble in organic solvent such as chloroform and benzene. **Waxes:** Solid ester of fatty acid ester . They are insoluble in water due to weak polar nature of ester group.

3) Define buffer? write its composition. (2 marks)

- 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,

A buffer solution (more precisely, pH buffer or hydrogen ion buffer) is an aqueous solution consisting of a mixture of a weak acid and its conjugate base, or vice versa. Its pH changes very little when a small amount of strong acid or base is added to it.

A buffer is a solution that can resist the pH changes upon the addition of acidic or basic components.

It is able to neutralize to very small amount of acid or base is added to it .

It is important for the process or reaction in which is require for the stable and pH ranges.

Buffer Composition:

To relatively the maintaining the pH of the solution , a buffer must consist the acid-base pair meaning either:

i) A weak base and a conjugate acid. ii) A

weak acid and conjugate base .

The use of one or more , depend upon the desired pH when preparing the buffer.

Example:

Acetic acid such as sodium acetate (CH_3COOH) in which they have conjugate acid .

Ammonia(NH_3) and a salt($NaCl$) in which they have conjugate base.

4) Define saponification Number? (3marks)

The number of milligrams of the sodium hydroxide and potassium hydroxide of free or combined state of fats or wax to completely saponifying are called **Saponification number**.

- Saponification
- 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 ($-\text{COOH}$) group present

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

5) Define enzyme kinetics? (3 marks)

Enzyme Kinetics. Enzymes are protein catalysts that, like all catalysts, speed up the rate of a chemical reaction without being used up in the process. They achieve their effect by temporarily binding to the substrate and, in doing so, lowering the activation energy needed to convert it to a product.

Enzyme kinetics is the study of the **chemical reactions** that are **catalysed** by **enzymes**. In enzyme kinetics, the **reaction rate** is measured and the effects of varying the conditions of the reaction are investigated. Studying an enzyme's **kinetics** in this way can reveal the catalytic mechanism of this enzyme, its role in **metabolism**, how its activity is controlled, and how a **drug** or an agonist might **inhibit** the enzyme.

Enzyme kinetics is the investigation of how substrate bind with enzyme then into product. They are used to kinetic analysis are commonly obtained from an enzyme. In 1913 the Leonor Michaelis and Muad Leonora Menton are proposed quantitative theory of enzyme.

The molecules of the substrate bind reversibly with enzyme are called enzyme substrate complex.

These molecules are converted into product are called enzyme product complex.

These theory are further are further developed by J.B.S haldan and G.E briggs who derived equation to still widely used today.

Enzyme Kinetics depend upon the solution condition and saturation concentration.

6) Medical applications of Nucleotides and nucleic acid. (3 marks)

- Medical applications Specifically medical applications include the use of synthetic purine and pyrimidine analogs that contain halogens, thiols, or additional nitrogen atoms;
- Their 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

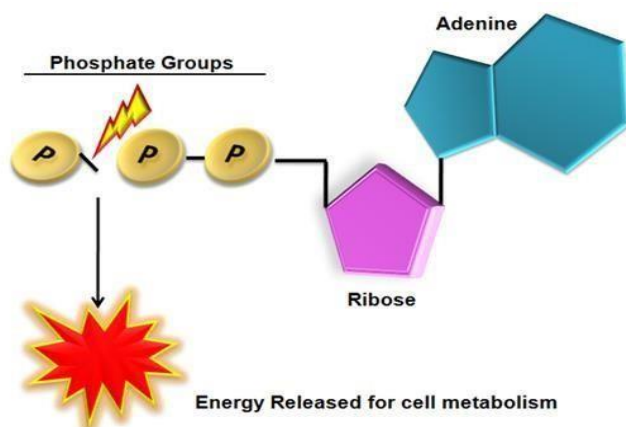
7) Properties of waxes (5 marks)

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) they are of no nutritional value

8) nucleotides as 'energy currency' of the cell? (5 marks)

- Energy currency: 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

9) classification of enzymes? (5 marks)

There were six classes of enzymes that were created so that enzymes could easily be named. These classes are:

- 1) Oxidoreductases,
- 2) Transferases,
- 3) Hydrolases,
- 4) Lyases,
- 5) Isomerases, 6) Ligases.

This is the international classification used for enzymes.

10) Define enzymes? Write classification of enzymes? (10 marks)

Enzymes are protein molecules in cells which work as catalysts. **Enzymes** speed up chemical reactions in the body, but do not get used up in the process. Almost all biochemical reactions in living things need **enzymes**. With an **enzyme**, chemical reactions go much faster than they would without the **enzyme**.

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CLASSIFICATION OF ENZYMES		
Group of Enzyme	Reaction Catalysed	Examples
1. Oxidoreductases	Transfer of hydrogen and oxygen atoms or electrons from one substrate to another.	Dehydrogenases Oxidases
2. Transferases	Transfer of a specific group (a phosphate or methyl etc.) from one substrate to another.	Transaminase Kinases
3. Hydrolases	Hydrolysis of a substrate.	Estrases Digestive enzymes
4. Isomerases	Change of the molecular form of the substrate.	Phospho hexo Isomerase, Fumarase
5. Lyases	Nonhydrolytic removal of a group or addition of a group to a substrate.	Decarboxylases Aldolases
6. Ligases (Synthetases)	Joining of two molecules by the formation of new bonds.	Citric acid synthetase

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1) Oxidoreductases

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

2) 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
- Transaminases
- Phosphotransferases (Kinases)
- Hexokinase is a phosphotransferase which catalyze the transfer of phosphate groups.
- $\text{Glucose} + \text{ATP} \rightarrow \text{Glucose 6-phosphate} + \text{ADP}$.

3) 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 • Phospholipases.

4) Lyases

- These 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.

5) 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.

6) 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.

11) components of nucleotide 3

Nucleotides are composed of

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

12) Characteristics of VLDL .5

very-low-density lipoproteins (VLDL),

- VLDLs 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.

13) what is lipoproteins 2

Combinations of lipid and protein (lipoproteins) serve as the means of transporting lipids in the blood, Importantly, lipids provide the hydrophobic barrier that permits partitioning the aqueous contents of cells and subcellular structures as; phospholipids and sterols are the major structural elements of biological membranes.

- Different combinations of lipids and proteins produce particles of different densities
- ranging from chylomicrons to high-density lipoproteins

A **lipoprotein** is a **biochemical** assembly whose primary purpose is to transport **hydrophobic lipid** (a.k.a. **fat**) molecules in water, as in blood or **extracellular fluid**. They have a single-layer **phospholipid** and **cholesterol** outer shell, with the **hydrophilic** portions oriented outward toward the surrounding water and **lipophilic** portions of each molecule oriented inwards toward the lipids molecules within the particles.

14) five functions of cyclic AMP 5

- 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⁺ & Ca²⁺
- 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

cAMP, cyclic AMP, or 3',5'-cyclic adenosine monophosphate) is a second messenger important in many biological processes. cAMP is a derivative of adenosine triphosphate (ATP) and used for

intracellular signal transduction in many different organisms, conveying the cAMP- dependent pathway

15) define glycerol 3 marks

Glycerol is widely used in pharmaceutical and cosmetic preparations.

It has the following properties: • Colorless • Viscous oily liquid with • sweet taste.

16) Two properties of glycerol trinitrate. 2 marks

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

17) name of Three pyrimidine bases.3 marks.

- **Pyrimidines:**
- **Pyrimidines include:** • Cytosine (C)—in both DNA and RNA
- Thymine (T)—only in DNA
- Uracil (U) —only in RNA
-
- Cytosine when combines with pentose it becomes deoxycytidine and cytidine
- Thymine becomes thymidine and deoxythymidine
- Uracil (U) becomes uridine and deoxyuridine depending on the type of sugar.
- Cytosine is 2-oxy-4-amino-pyrimidine
- Thymine is 2,4-dioxy-5-methyl-pyrimidine • Uracil is 2,4-dioxy-pyrimidine •
- T and U differ by only one methyl group, which is present on T but absent on U

18) explain bees wax and spermaceti.3 marks

Bees-wax is secreted by the honeybees that use it to form the combs. It is a mixture of waxes

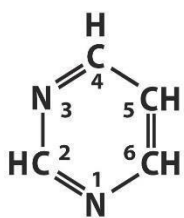
chief constituent is myricyl palmitate

Spermaceti • is a wax that is most often found in the head cavities of the sperm whale. • Fatty esters are formed essentially of • cetyl palmitate and • cetyl myristate. It was used in cosmetics, pharmacy and also in candles • recent international regulation concerning whale captures, has stopped its use. It is now replaced by synthetic cetyl palmitate.

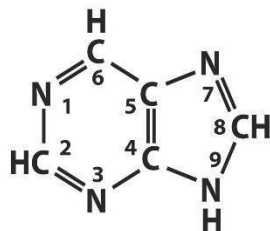
19) write five Properties of nitrogenous bases.5 marks

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.



Pyrimidine



Purine

- **Weak Bases:** Purines or pyrimidines with an -NH_2 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 three-dimensional structure of nucleic acids.

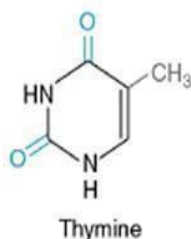
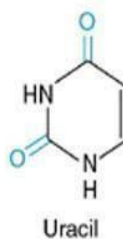
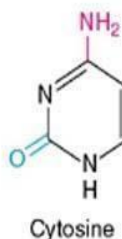
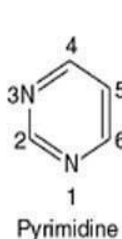
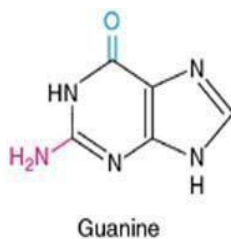
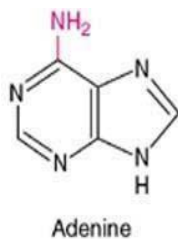
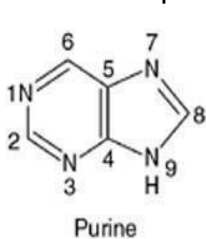
20. composition of triacylglycerol 2

- 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

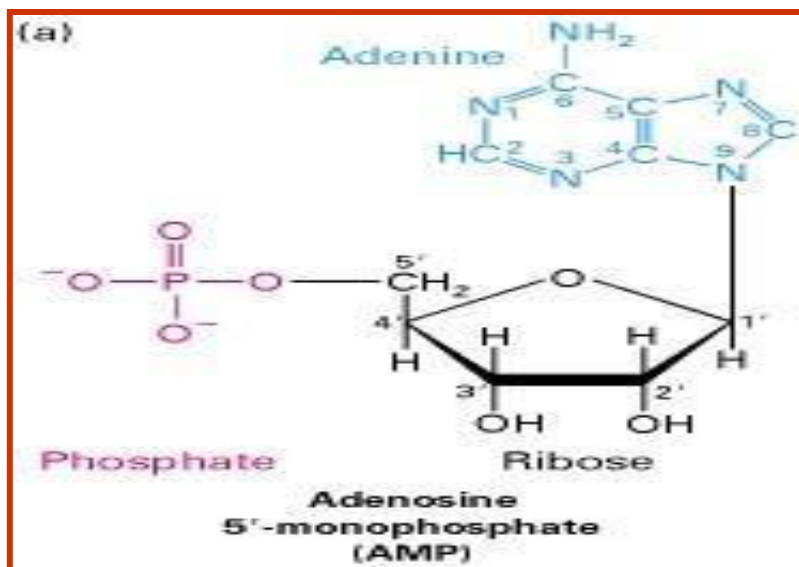
21. carbon atom number in pentose sugar of nucleotides & nucleosides 3

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.



- Thus, when the 5'-carbon of a nucleoside (or nucleotide) is referred to, a carbon atom in the pentose, rather than an atom in the base, is being specified.

22. Nucleotide serve as single transduction pathway? 3

- 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;
- Their use includes chemotherapy for cancer
- as suppressors of the immune response during organ transplantation. as anti-viral drugs such as in the treatment of AIDS

8. What is km in Micheals Mntn Equatin 3

23 Rancidity and its factors 5marks

- Rancidity
- Definition:
- 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.
- **Rancidity is due to**
- Oxidation • Hydrolysis • Oxidative Rancidity

Rancidity is a very general term and in its most general meaning, it refers to the spoilage of a food in such a way that it becomes undesirable (and usually unsafe) for consumption. When people say that a food has "gone bad," what they're usually talking about is rancidity. Rancidification. Rancidity is the complete or incomplete oxidation or hydrolysis of fats and oils when exposed to air, light, moisture or by bacterial action, resulting in unpleasant taste and odor. ... When these processes occur in food, undesirable odors and flavors can result.

24.Name the pentose sugar in nucleic acids 5marks

- D-ribose and 2-deoxy D-ribose are the only sugars so far found in the nucleic acids.
- These also pentoses belong to D-family
- They are present as Furanose (ring) in the form of β -Anomer
- The addition of a pentose sugar to a base produces a nucleoside
- If the sugar is D-ribose, a ribonucleoside is produced
- If the sugar is 2-deoxy D-ribose, a deoxyribonucleoside is produced

Enzymes...classification 10marks

25) halogenation with respect to fat 5 marks

Halogenation

- 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.

26) define function of lipoxin 2 marks

- 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.

27 Nucleoside vs. Nucleotide

A **nucleoside** consists of a nitrogenous base covalently attached to a sugar (ribose or deoxyribose) but without the phosphate group. A


nucleotide consists of a nitrogenous base, a sugar (ribose or deoxyribose) and one to three phosphate groups.

Nucleoside = Sugar + Base

Nucleotide = Sugar + Base + Phosphate

Comparison chart

Nucleoside versus Nucleotide comparison chart

	 Nucleoside	Nucleotide
Chemical Composition	Sugar + Base. A nucleoside consists of a nitrogenous base covalently attached to a sugar (ribose or deoxyribose) but without the phosphate group. When phosphate group of nucleotide is removed by hydrolysis, the structure remaining is nucleoside.	Sugar + Base + Phosphate. A nucleotide consists of a <u>nitrogenous base</u> , a sugar (ribose or deoxyribose) and one to three phosphate groups.
Relevance in medicine	Several nucleoside analogues are used as antiviral or anticancer agents.	Malfunctioning nucleotides are one of the main causes of all cancers known of today.
Examples	Examples of nucleosides include cytidine, uridine, adenosine, guanosine, thymidine and inosine.	Nucleotides follow the same names as nucleosides, but with the indication of phosphate groups. For example, 5'-uridine monophosphate.

Nucleotide: Nucleotide is composed of a nitrogenous base, sugar and a phosphate group.

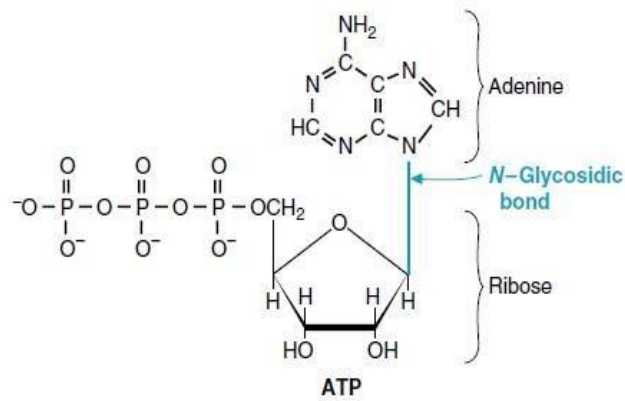
Nucleoside: Nucleoside is composed of only a nitrogenous base and a phosphate group

28 iodine number

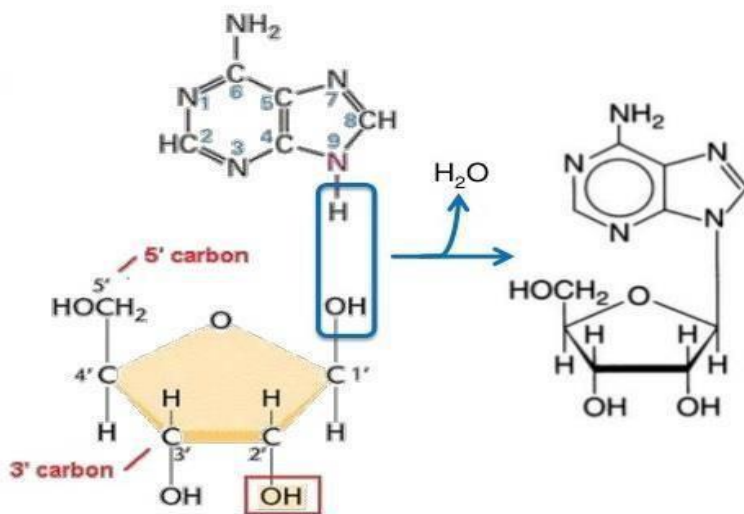
- Iodine number is defined as the number of grams of iodine absorbed by 100 gm of fat.
- The more the iodine number, the greater the degree of unsaturation.
- Fats rich in saturated fatty acids have low iodine numbers,
- while fats rich in unsaturated fatty acids have high iodine numbers

29 example of condensation reaction .2mrks

- Sugars are linked to the heterocycle by a β -N-glycosidic bond, almost always to the
- N-1 of a pyrimidine
- N-9 of a purine



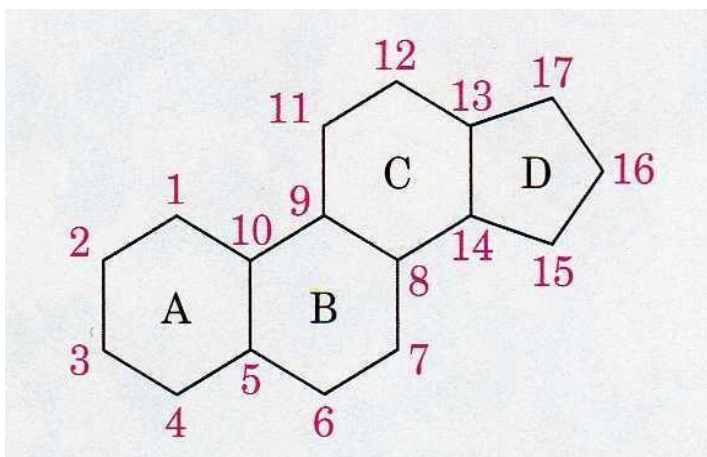
- The N-glycosyl bond is formed by removal of the elements of water
- a hydroxyl group from the pentose and
- hydrogen from the base



- Thus it is a condensation reaction.
- Similar to O-glycosidic bond formation in carbohydrates
- However, N-glycosidic bonds, have Nitrogen atom instead of oxygen linking the two residues. • the addition of the glycosidic bond to nitrogenous base is indicated by the name change
- such as from adenine to adenosine for the glycosidic bond

30 Steroids and Cholesterol

- A steroid is a lipid whose structure is based on the tetracyclic (four-ring) structure consists of
- 3 cyclohexane rings.
- 1 cyclopentane ring.



- 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