ID 16167
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Paper biochemistry

Question no: 1

- The unified cell theory states that: all living things are composed of one or more cells; the cell is the basic unit of life; and new cells arise from existing cells. Rudolf Virchow later made important contributions to this theory.

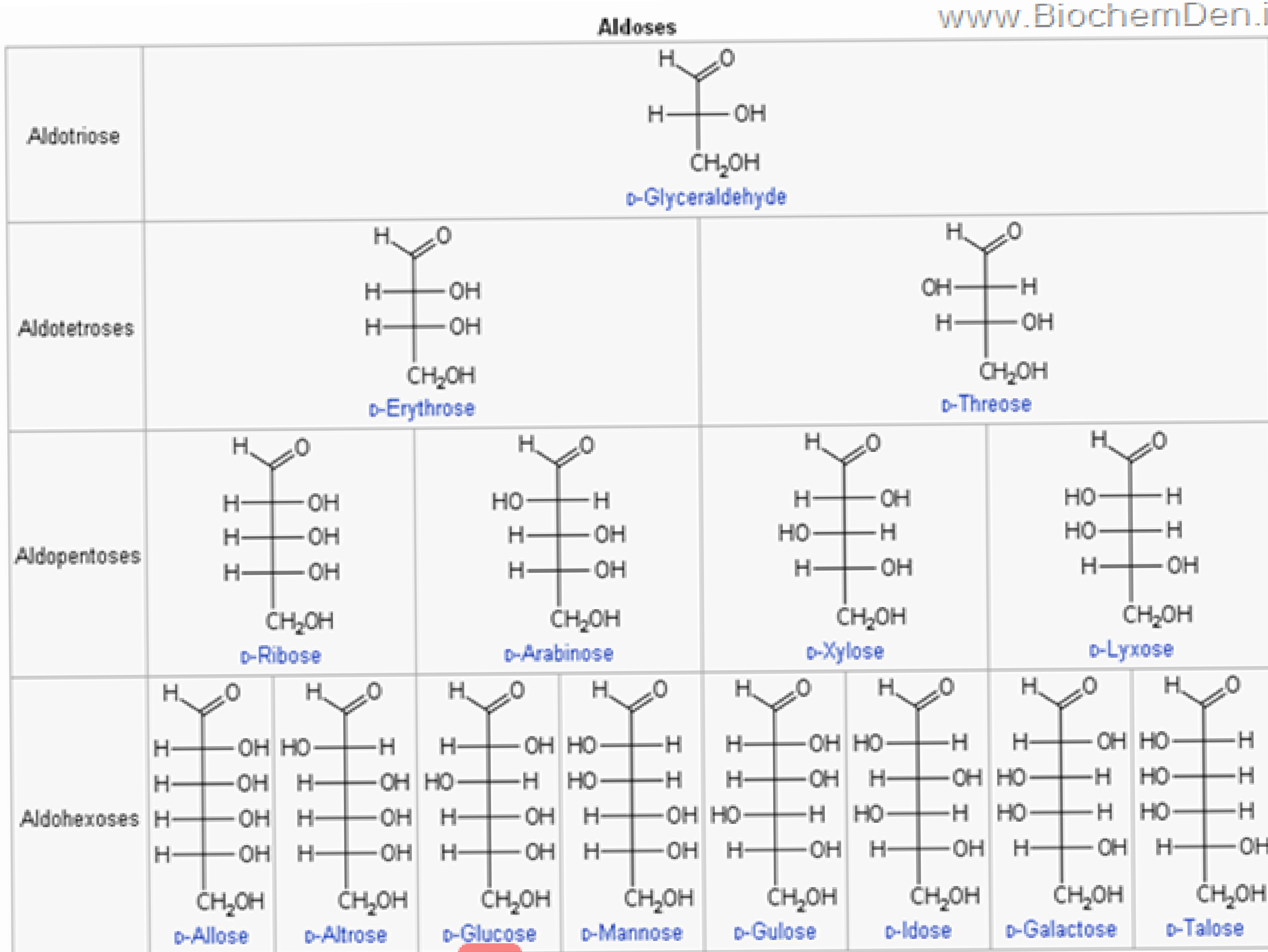
- **Summary**. Four basic principles or theories unify all fields of biology. Those principles are cell theory, gene theory, homeostasis, and evolutionary theory. According to cell theory, all living things are made of cells and come from other living cells

Early cell theory was comprised of four statements, the first being: “All organisms are made up of cells.” When I say organisms, that means all living things. Everything that lives is made up of cells. The second part of cell theory was that new cells are formed from preexisting cells. Part 3: All cells are similar

Question no:2

- Monosaccharides can be classified by the number x of carbon atoms they contain: triose (3), tetrose (4), pentose (5), hexose (6), heptose (7), and so on. Glucose, used as an energy source and for the synthesis of starch, glycogen and cellulose, is a hexose.

- . Number of Carbon Atoms
- Monosaccharides with three carbon atoms are called trioses, those with four are called tetroses, five are called pentoses, six are hexoses, and so on. These two systems of classification are often combined. For example, glucose is an aldohexose (a six-carbon aldehyde), ribose is an aldopentose (a five-carbon aldehyde), and fructose is a ketohexose (a six-carbon ketone). Various examples of other monosaccharide are given in the following table.


Aldoses
Aldotriose
D-Glyceraldehyde
Aldotetroses
D-Erythrose
D-Threose
Aldopentoses
D-Ribose
D-Arabinose
D-Xylose
D-Lyxose
Aldohexoses
D-Allose
D-Altrose
D-Glucose
D-Mannose
D-Gulose
D-Idose
D-Galactose
D-Talose

Trioses

- A triose is a monosaccharide containing three carbon atoms. The general formula is $C3H6O3$. There are only two trioses, an aldotriose (glyceraldehyde) and a ketotriose (dihydroxyacetone). Trioses are important in respiration. Namely, lactic acid and pyruvic acid are derived from aldotriose and ketotriose, respectively.

Tetroses

- A tetrose is a monosaccharide containing four carbon atoms. The general formula is C4H8O4. Example:D- Erythrose-4-P is an intermediate in hexosemonophosphate shunt which is an alternative of glucose oxidation

Pentoses

- A pentose is a monosaccharide containing five carbon atoms. The general formula is $C_5H_{10}O_5$.
- Example of Pentoses are
- D- ribose is a constituent of RNA and many co-enzymes e.g. FAD, NAD.
- D-2 deoxy is a constituent of DNA component of DNA.
- D-Lyxose is a constituent of lyxoflavin found in the human heart.
- D- arabinose is a constituent of plant cell wall
- Phosphate esters of D- Ribulose and D- xylose occurs as an intermediate in the HMP pathway

Hexoses

- A Hexose is a monosaccharide containing six carbon atoms. The general formula is $C_6H_{12}O_6$
- D- Glucose
- It is the chief physiological sugar present in human blood. Its values are regulated between 70-110 mg/dl of blood by a pancreatic hormone Insulin and Glucagon. Increase in blood sugar levels leads to Diabetes. All tissues utilize glucose for energy. Brain and

Erythrocytes depend exclusively on glucose. Its polymeric form glycogen is used as energy storage material in animals. Its polymeric form starch is used as energy storage material in plants.

- carbohydrates as either simple or complex, however, the exact delineation of these categories is ambiguous. Today, the term simple carbohydrate typically refers to monosaccharides and disaccharides, and complex carbohydrate means polysaccharides (and oligosaccharides).

Question no: 3

- The principal components of the plasma membrane are lipids (phospholipids and cholesterol), proteins, and carbohydrate groups that are attached to some of the lipids and proteins. A phospholipid is a lipid made of glycerol, two fatty acid tails, and a phosphate-linked head group.

Macromolecules

The term macromolecule was coined by Nobel laureate Hermann Staudinger in the 1920s, although his first relevant publication on this field only mentioned high molecular compounds (in excess of 1000 atoms). At that time the phrase polymer as introduced by Berzelius in 1833 had a different meaning from that of today: it simply was another

- form ofisomerism, such as an enzene or acetylene, and had little to do with size. Some examples of organic macromolecules are bio-polymers (carbohydrates, proteins, lipids, nucleic acids) or polymers (plastics, synthetic fiber and rubber).

Carbohydrates

- A carbohydrate (kɑ:bəˈhaɪdreɪt/) is an organic compound which has the empirical formula Cm(H2O)n; that is, consists only of carbon, hydrogen and oxygen, with a hydrogen:oxygen atom ratio of 2:1 (as in water). Carbohydrates can be viewed as hydrates of carbon, hence their name. Structurally however, it is more accurate to view them as polyhydroxy aldehydes and ketones. Historically nutritionists have classified

Monosaccharides

- Monosaccharides (from Greek monos: single, sacchar: sugar) are the most basic units of biologically important carbohydrates. They are the simplest form of sugar and are usually colorless, water-soluble, crystalline solids. Some monosaccharides have a sweet taste. Examples of monosaccharides include glucose (dextrose), fructose (levulose), galactose, xylose and ribose. Monosaccharides ar

- e the building blocks of disaccharides such as sucrose and polysaccharides (such as cellulose and starch). Further, each carbon atom that supports a hydroxyl group (except for the first and last) is chiral, giving rise to a number of isomeric forms all with the same chemical formula. For instance, galactose and glucose are both aldohexoses, but have different chemical and physical properties.

Disaccharide

A disaccharide or biose is the carbohydrate formed when two monosaccharides undergo a condensation reaction which involves the elimination of a small molecule, such as water, from the functional groups only. Like monosaccharides, disaccharides also dissolve in water, taste sweet and are called sugars. The glycosidic bond can be formed between any hydroxyl group on

- the component monosaccharide. So, even if both component sugars are the same (e.g., glucose), different bond combinations (regiochemistry) and stereochemistry (alpha- or beta-) result in disaccharides that are diastereoisomers with different chemical and physical properties.

Oligosaccharide

An oligosaccharide (from the Greek oligos, a few, and sacchar, sugar) is a saccharide polymer containing typically three to ten component sugars, also known as many as 8 sugars, or polysaccharides. Oligosaccharides can have many functions; for example, they are commonly found on the plasma membrane of animal cells where they can play a role in cell-cell recognition. In general, they are found either O- or N-linked to compatible amino acid side-chains in proteins or to lipid moieties. e.g.Fructo-oligosaccharides (FOS), which are found in many vegetables, consist of short chains of fructose molecules.

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Polysaccharides

- Polysaccharides are polymeric carbohydrate structures, formed of repeating units (either mono- or di-saccharides) joined together by glycosidic bonds. These structures are often linear, but may contain various degrees of branching. Polysaccharides are often quite heterogeneous, containing slight modifications of the repeating unit. Depending on the structure, these macromolecules can have distinct properties from their monosaccharide

- of the repeating unit. Depending on the structure, these macromolecules can have distinct properties from their monosaccharide building blocks.

QUESTION NO 4

- Both animal and plant proteins are made up of about 20 common amino acids. The proportion of these amino acids varies as a characteristic of a given protein, but all food proteins—with the exception of gelatin—contain some of each. Amino nitrogen accounts for approximately 16% of the weight of proteins.

. Amino acids are required for the synthesis of body protein and other important nitrogen-containing compounds, such as creatine, peptide hormones, and some neurotransmitters. Although allowances are expressed as protein, a the biological requirement is for amino acids.

- Proteins and other nitrogenous compounds are being degraded and resynthesized continuously. Several times more protein is turned over daily within the body than is ordinarily consumed, indicating that reutilization of amino acids is a major feature of the economy of protein metabolism. This process of recapture is not completely efficient, and some amino acids are lost by oxidative catabolism

- Metabolic products of amino acids (urea, creatinine, uric acid, and other nitrogenous products) are excreted in the urine; nitrogen is also lost in feces, sweat, and other body secretions and in sloughed skin, hair, and nails. A continuous supply of dietary amino acids is required to replace these losses, even after growth has ceased.

- Amino acids consumed in excess of the amounts needed for the synthesis of nitrogenous tissue constituents are not stored but are degraded; the nitrogen is excreted as urea, and the keto acids left after removal of the amino groups are either utilized directly as sources of energy or are converted to carbohydrate or fat.

- Nine amino acids—histidine, isoleucine, leucine, lysine, methionine, phenylalanine, threonine, tryptophan, and valine—are not synthesized by mammals and are therefore dietarily essential or indispensable nutrients. These are commonly called the essential amino acids. Histidine is an essential amino acid for infants, but was not demonstrated to be required by adults until recently

Question no:5

Overview

- Carbohydrates in the diet provide the major exogenous source for glucose, which is the primary
- energy source for cells. They account for 40-60% of the calories in the western diet and higher
- percentages in protein scarce diets. Each gram of carbohydrate provides 4 calories.

- arbohydrates are hydrophilic and require a series of reactions to digest them to
- monosaccharides which are absorbed in the small intestine. Carbohydrates consist of three main
- groups, simple carbohydrates (monosaccharides), disaccharides and complex carbohydrates

- (starch, glycogen, and fiber). The common monosaccharides include glucose, fructose,
- galactose, xylose and ribose. The varying molecular arrangements result in varying degrees of
- sweetness, with fructose being the sweetest. Disaccharides are created by the condensation of
- two monosaccharides and require hydrolysis for separation at the time of absorption

Digestion

- The goal of carbohydrate digestion is to break down all disaccharides and complex
- carbohydrates into monosaccharides for absorption, although not all are completely absorbed in
- the small intestine (e.g., fiber). Digestion begins in the mouth with salivary amylase released
- during the process of chewing. There is a positive feedback loop resulting in increased oral
- amylase secretion in people consuming diets high in carbohydrates. The amylase is synthesized

- in the serous cells of the salivary glands. Amylase breaks starches into maltose and
- polysaccharides. Amylase is sensitive to pH and thus is inhibited in the acidic environment of
- the stomach. Only 5% of starch is broken down by salivary amylase due to limited
- exposure. Salivary amylase has increased importance in two groups; infants with decreased
- pancreatic amylase production in the first 9 months and children with pancreatic insufficiency
- from cystic fibrosis or other etiologies.
- Minimal carbohydrate digestion occurs in the stomach due to the inactivation of amylase in the

Absorption

- Once carbohydrates are digested, the products must be absorbed and transported to the portal
- circulation. Digestion and absorption are typically coupled, with the enzymes closely located to
- the appropriate transporters. Glucose absorption occurs in the small intestine via the SGLT-1
- transporter (sodium glucose co-transporter). Fructose absorption is completed via the GLUT5
- transporter by facilitated diffusion.

- Glucose and galactose are actively transported from the small intestine lumen by the sodium
- glucose transporter (SGLT-1) located in the brush border of the small intestine. The transporter
- is more prevalent in the duodenum and jejunum. Glucose transport is driven by a sodium
- gradient across the apical cell membrane generated by the Na+
- ,K+
- -ATPase pump located in the

- basolateral membrane of the enterocyte. The Na+
- ,K+
- -ATPase pump creates a low intracellular
- sodium concentration by transporting 3 Na+
- ions out of the cell and 2 K+
- ions into the cell. The
- SGLT-1 transporter utilizes the sodium gradient. Two Na+
- ions bind to the outer face of the
- SGLT-1 transporter which results in a conformational change permitting subsequent glucose

- binding. The two Na+
- ions and the glucose molecule are then transferred to the cytoplasmic side
- of the membrane following another conformational change that involves rotation of the receptor.
- The glucose is released first followed by the sodium ions. The sodium is transported from high

- to low concentration (with concentration gradient) and at the same time allows the carrier to
- transport glucose against its concentration gradient. The Na^+
- ion is subsequently expelled by
- Na^+
- ,K^+
- -ATPase pump to maintain the gradient. The SGLT-1 transporter undergoes another

- conformational change resulting in the binding sites again being exposed at the apical surface.
- This action can occur one thousand times per second. Much of the glucose transported into the
- cell passes out of the cell at basolateral surface by facilitated diffusion via GLUT-2. Sodium
- ions and accompanying anions and water follow the glucose, maintaining iso-osmolarity. A
- small portion of the glucose is utilized by the cell.
- Facilitated diffusion is the mechanism for fructose transport. Facilitated diffusion utilizes a

- There continues to be debate about passive glucose absorption. Recent data suggests passive
- glucose absorption does exist, but that it is a facilitated system mediated by glucose-dependent
- activation. The GLUT-2 facilitative glucose transporter can be recruited to the brush border
- membrane to assist with glucose transport.