WJEC (Eduqas) Biology A-level

Core Concept 1 - Biological compounds

Flashcards

Name the four key inorganic ions in living organisms.

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- Magnesium ions (Mg^{2+})
- Iron ions (Fe^{2+})
- Calcium ions (Ca^{2+})
- Phosphate ions (PO_4^{3-})

What is the role of Mg^{2+} in plants?

What is the role of Mg^{2+} in plants?

Mg^{2+} is used to produce chlorophyll.

What is the role of Fe^{2+} in animals?

What is the role of Fe^{2+} in animals?

Fe^{2+} is found in haemoglobin and is involved in the transport of oxygen.

What is the role of PO_4^{3-} in living organisms?

What is the role of PO_4^{3-} in living organisms?

PO_4^{3-} is used to produce ADP and ATP.

What is the role of Ca^{2+} in living organisms?

What is the role of Ca^{2+} in living organisms?

Ca^{2+} is used to strengthen tissues such as bones and teeth in animals and cell walls in plants.

Why is water a polar molecule?

Why is water a polar molecule?

O is more electronegative than H. O attracts the electron density in the covalent bond more strongly, forming δ- O and δ+ H.

Describe hydrogen bonding between water molecules.

Describe hydrogen bonding between water molecules.

Weak intermolecular forces of attraction form between a lone pair on a δ- O and a δ+ H on an adjacent molecule.

What is a metabolite?

What is a metabolite?

A molecule formed or used in metabolic reactions.

Describe the role of water as a metabolite.

Describe the role of water as a metabolite.

Water is a reactant in photosynthesis and hydrolysis reactions. Water is a product in aerobic respiration and condensation reactions.

Why is water's high specific heat capacity important for organisms?

Why is water's high specific heat capacity important for organisms?

Water acts as a temperature buffer, enabling endotherms to resist fluctuations in core temperature and to maintain optimum enzyme activity.

Why is water's high latent heat of vaporisation important for organisms?

Why is water's high latent heat of vaporisation important for organisms?

When water evaporates, it has a cooling effect. This is important in homeostasis; organisms can lose heat through sweating or panting.

Why is water an important solvent for organisms?

Why is water an important solvent for organisms?

Water is a polar universal solvent. It enables chemical reactions to take place within cells, the transport of materials in the plasma and the removal of metabolic waste.

Why does water have a high surface tension?

Why does water have a high surface tension?

Due to the ordered arrangement and cohesion of molecules at the surface of water.

Why is the high surface tension of water important for organisms?

Why is the high surface tension of water important for organisms?

- Enables the transport of water and nutrients through plants stems and small blood vessels in the body
- Allows small insects to ‘walk’ on water

What is a monosaccharide?

What is a monosaccharide?

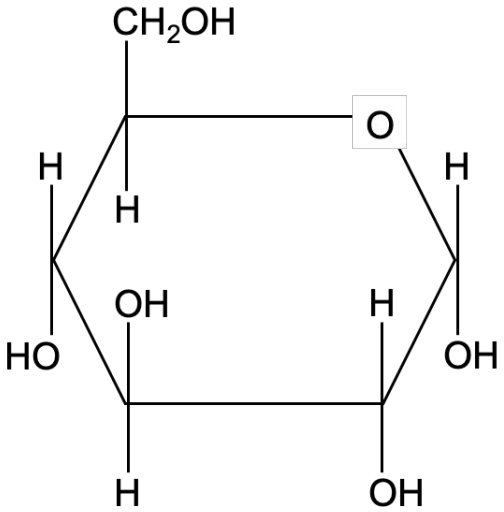
- Simple sugar
- General formula $C_n(H_2O)_n$

Give some examples of monosaccharides.

Give some examples of monosaccharides.

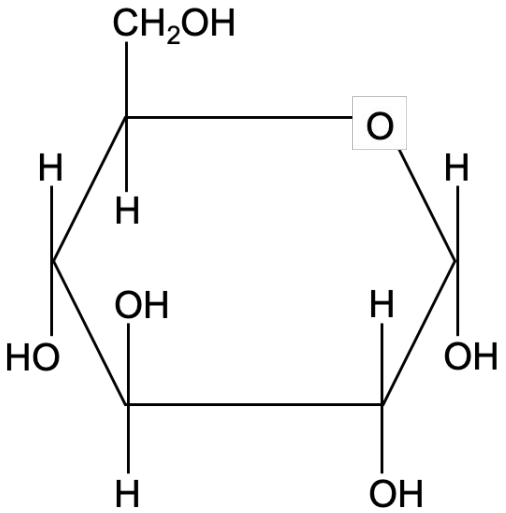
- Glyceraldehyde
- Ribose
- Deoxyribose
- α- and β- glucose
- Fructose
- Galactose

Identify the monosaccharide.

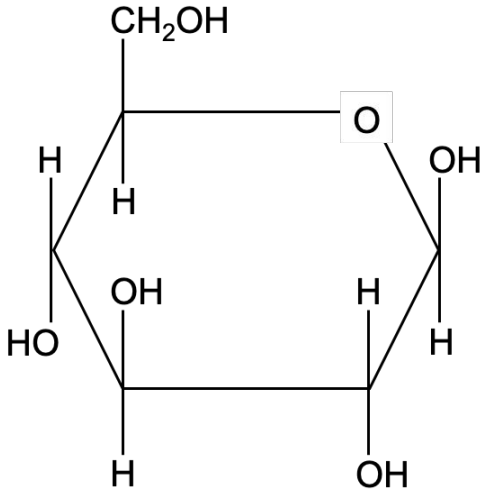


Identify the monosaccharide.

α-glucose

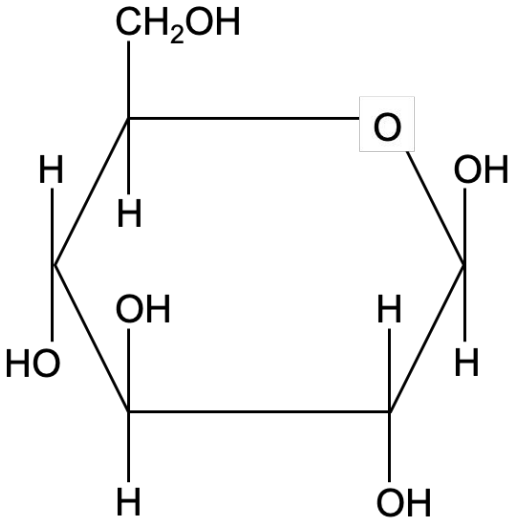


Identify the monosaccharide.

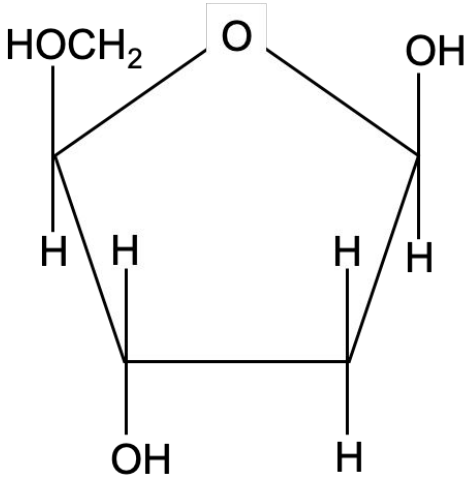


Identify the monosaccharide.

β-glucose

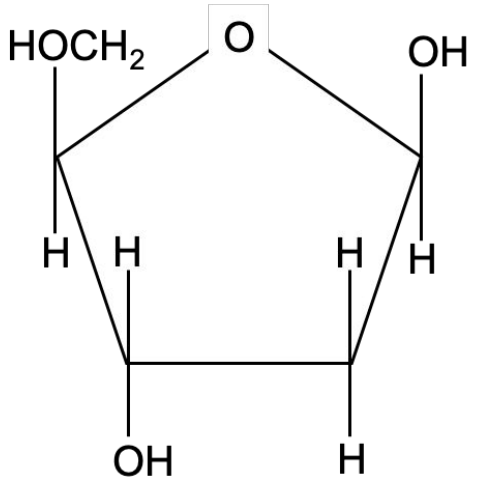


Identify the monosaccharide.

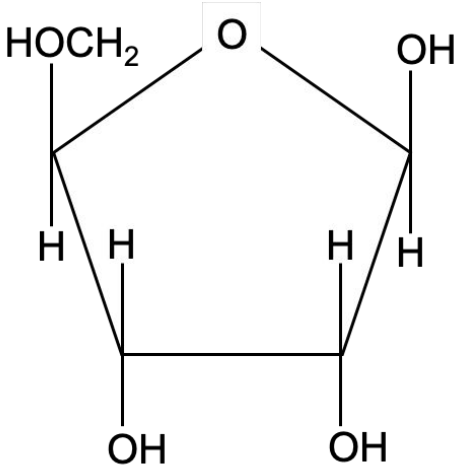


Identify the monosaccharide.

Deoxyribose

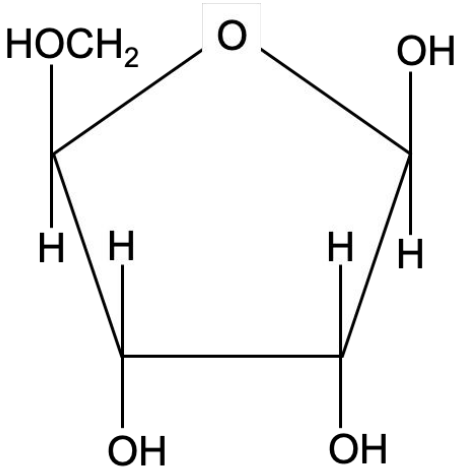


Identify the monosaccharide.



Identify the monosaccharide.

Ribose



What is the name of the bond formed when two monosaccharides react?

What is the name of the bond formed when two monosaccharides react?

Glycosidic bond

What is a disaccharide?

What is a disaccharide?

- Molecule formed by the condensation of two monosaccharides, forming a glycosidic bond
- Formula $C_{12}H_{22}O_{11}$

Give some examples of disaccharides and their monosaccharide constituents.

Give some examples of disaccharides and their monosaccharide constituents.

- Sucrose (Glucose-Fructose)
- Maltose (α-Glucose-α-Glucose)
- Lactose (Glucose-Galactose)

What is a polysaccharide?

What is a polysaccharide?

A polymer of monosaccharides, formed by many condensation reactions.

Give some examples of polysaccharides.

Give some examples of polysaccharides.

- Starch
- Glycogen
- Cellulose
- Chitin

What is the function of starch?

What is the function of starch?

Energy storage in plants.

Describe the structure of starch.

Describe the structure of starch.

- Polymer of α-glucose monomers
- Two forms: amylose and amylopectin
- Amylose: α-1,4-glycosidic bonds, unbranched
- Amylopectin: α-1,4- and α-1,6-glycosidic bonds, branched

What is the function of glycogen?

What is the function of glycogen?

Energy storage in animals.

How does the structure of glycogen relate to its function?

How does the structure of glycogen relate to its function?

It is highly branched enabling the rapid hydrolysis of glucose molecules.

Describe the structure and function of cellulose.

Describe the structure and function of cellulose.

- Linear polysaccharide that is the main component of the cell wall in plants
- Consists of many β-glucose molecules joined by β-1,4-glycosidic bonds
- Alternate glucose molecules rotated 180° allowing hydrogen bonds between parallel chains, forming myofibrils

Describe the structure and function of chitin.

Describe the structure and function of chitin.

- Linear polysaccharide found in the exoskeletons of insects and crustaceans as well as fungal cell walls
- Consists of many β-glucose molecules (with amino acid side chains) joined by β-1,4-glycosidic bonds
- Alternate glucose molecules rotated 180° allowing hydrogen bonds between parallel chains, forming myofibrils

Explain how a triglyceride is formed.

Explain how a triglyceride is formed.

One molecule of glycerol forms ester bonds with three fatty acids via condensation reactions.

Relate the structure of triglycerides to their functions.

Relate the structure of triglycerides to their functions.

- High energy-to-mass ratio - **energy storage**, high calorific value from oxidation
- Insoluble hydrocarbon chain - no effect on water potential of cells, used for **waterproofing**
- Slow conductor of heat - **thermal insulation**, e.g. adipose tissue
- Less dense than water - **buoyancy** of aquatic animals

What is a phospholipid?

What is a phospholipid?

A type of lipid formed by the condensation of one molecule of glycerol, two molecules of fatty acid and a phosphate group.

Relate the structure of phospholipids to their functions.

Relate the structure of phospholipids to their functions.

Glycerol backbone attached to two **hydrophobic** fatty acid tails and one **hydrophilic** polar phosphate head:

- Forms phospholipid bilayer in water - component of cell membranes
- Tails splay outwards - waterproofing, e.g. skin

What is the difference between saturated and unsaturated fats?

What is the difference between saturated and unsaturated fats?

- **Saturated fats** have no C=C bonds, and are solid at room temperature due to strong intermolecular forces

- **Unsaturated fats** have one or more C=C bonds, and are liquid at room temperature due to weak intermolecular forces

Differentiate between monounsaturated and polyunsaturated fatty acids.

Differentiate between monounsaturated and polyunsaturated fatty acids.

- Monounsaturated fatty acids contain one C=C bond
- Polyunsaturated fatty acids contain more than one C=C bond

What is meant by a low density lipoprotein (LDL)?

What is meant by a low density lipoprotein (LDL)?

- Combination of triglycerides from saturated fats and protein
- Blocks receptor sites, reducing cholesterol absorption
- Known as ‘bad’ lipoproteins

How do LDLs contribute to the risk of cardiovascular disease?

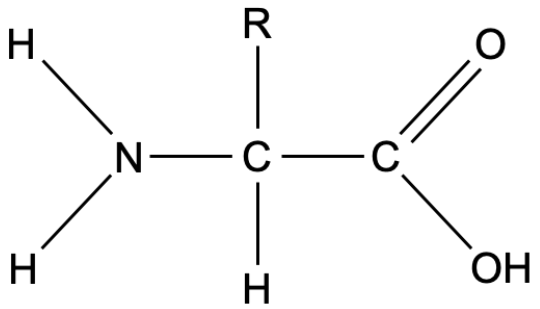
How do LDLs contribute to the risk of cardiovascular disease?

The high blood cholesterol level caused by LDLs leads to formation of atherosclerosis plaques.

Describe the general structure of an amino acid.

Describe is the general structure of an amino acid.

- Amine group ($-NH_2$)
- Variable side chain (R)
- Carboxyl group (-COOH)
- H atom



How are polypeptides formed?

How are polypeptides formed?

Many amino acid monomers join together in condensation reactions, forming peptide bonds (-CONH-).

What is the primary structure of a protein?

What is the primary structure of a protein?

The individual sequence of amino acids in a protein.

Describe the secondary structure of a protein.

Describe the secondary structure of a protein.

The local interactions of the amino acids in the polypeptide chain resulting in α-helices or β-pleated sheets. Hydrogen bonds hold the arrangements in place.

Describe the tertiary structure of a protein.

Describe the tertiary structure of a protein.

The folding of a protein to make a three-dimensional structure. Held in place by various interactions and bonds:

- Disulfide bonds
- Ionic bonds
- Hydrogen bonds
- Hydrophobic interactions

Describe the quaternary structure of a protein.

Describe the quaternary structure of a protein.

- Interactions of more than one polypeptide chain
- May involve addition of prosthetic groups, e.g. metal ions or phosphate groups

Describe how the structure of fibrous proteins relates to their function.

Describe how the structure of fibrous proteins relates to their function.

- Long polypeptide chains, folded in parallel
- Little tertiary/quaternary structure aside from cross-linkages for strength
- This makes them insoluble and good for structural roles

Describe how the structure of globular proteins relates to their function.

Describe how the structure of globular proteins relates to their function.

- Spherical, compact, highly folded with complex tertiary/quaternary structures
- Hydrophilic R groups face outwards and hydrophobic R groups face inwards ∴ water-soluble
- Metabolic roles, e.g. enzymes

What is the difference between a reducing and non-reducing sugar?

What is the difference between a reducing and non-reducing sugar?

- A reducing sugar has a free aldehyde or ketone functional group so can act as a reducing agent
- A non-reducing sugar does not have a free aldehyde or ketone functional group so it cannot act as a reducing agent

Describe the Benedict's test for reducing sugars.

Describe the Benedict's test for reducing sugars.

1. Add an equal volume of the sample being tested and Benedict's reagent
2. Heat the mixture in an electric water bath at 100°C for 5 minutes
3. Observe the colour of the precipitate formed

Describe the positive result for reducing sugars.

Describe the positive result for reducing sugars.

Colour change from green to yellow to orange to brown to a brick red depending on the quantity of reducing sugar present.

Describe the Benedict's test for non-reducing sugars.

Describe the Benedict's test for non-reducing sugars.

1. Negative test for reducing sugar
2. Hydrolyse non-reducing sugars with an equal volume of dilute HCl
3. Heat in a boiling water bath for 5 minutes
4. Add $NaHCO_3$ to neutralise the acid
5. Re-test resulting solution with Benedict's reagent
6. Observe the colour of the precipitate formed

Describe the positive result for non-reducing sugars.

Describe the positive result for non-reducing sugars.

Colour change from green to yellow to orange to brown to brick red depending on the quantity of non-reducing sugar present.

Name the food test used to identify proteins.

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Biuret test

Describe the biuret test.

Describe the Biuret test.

1. Add an equal volume of the sample to be tested and NaOH
2. Add a few drops of dilute copper (II) sulfate solution
3. Mix gently and record any observations

Describe the positive result of a biuret test.

Describe the positive result of a biuret test.

Colour change from pale blue to purple.

Describe the iodine-potassium iodide test for starch.

Describe the iodine-potassium iodide test for starch.

- Add iodine-KI solution
- Colour change from orange to blue-black in the presence of starch

Describe the emulsion test for fats and oils.

Describe the emulsion test for fats and oils.

- Add ethanol to the sample and shake
- Allow the mixture to settle
- Add an equal volume of water
- Record any observations

Describe the positive result of an emulsion test.

Describe the positive result of an emulsion test.

White, cloudy emulsion forms.