Macromolecules Concept Questions - SOLUTIONS

Carbohydrates

1. Explain the relationship between monomers and polymers, using polysaccharides as an example.

Monomers are the building blocks of polymers. Polymers are many repeating subunits (monomers). ex. glucose in the monomer of the polymer starch.

2. Why can't cellulose be used by humans as an energy source? Explain.

The β-glycosidic linkages cannot be broken down by the enzymes in human digestive systems, therefore the energy stored in the bonds cannot be used.

3. Why is fibre (*i.e.*, cellulose) considered to be an important part of a healthy diet?

It keeps materials moving through the intestines.

4. Name four examples of polysaccharides and state their primary function.

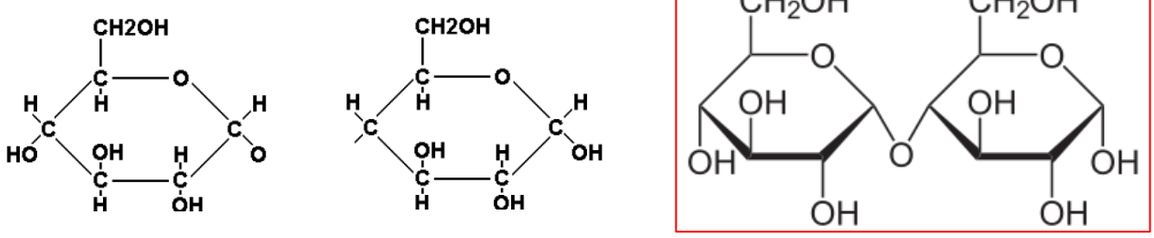
starch – energy storage

glycogen – energy storage

chitin – formation of exoskeleton (structural component of animal shells ex. lobseter)

cellulose –structural support in plant cells

5. Two monomers are being linked together in the diagram below to form what new compound? Complete the bond that joins these two compounds together.



b. What are the products of this reaction?
maltose & water

c. What type of linkage connects these two compounds together? 1-4, glycosidic linkage

d. What is the name given to this type of reaction? anabolic/condensation reaction/dehydration synthesis

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Lipids

6. a) How does the structure of an unsaturated fatty acid differ from the structure of a saturated fatty acid?

Saturated fats have single bonds between carbons in fatty acid chains

Unsaturated fats have one or more double bonds between carbons in fatty acid chains.

b) Give an example of a food that contains each.

Saturated – butter Unsaturated – vegetable oil

7. Explain why some fatty acids are solid at room temperature while others are liquid.

Saturated fatty acid chains are close enough together that they can form weak bonds that allow them to stick to one another make the molecules less likely to move past each other creating a solid.

8. a) When you consume more food than you need for energy, the excess is stored in the form of lipids. Why are lipids particularly useful for this purpose?

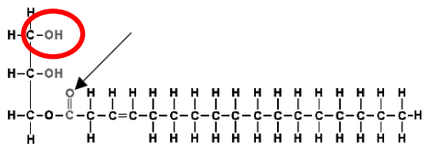
They are much more compact form of storage than other macromolecules such as carbohydrates.

9. What property do all lipids share? How does this make them ideal for building cell membranes?

Part or all of the molecules is hydrophobic. This makes it difficult for water and dissolved molecules to move in and out of the cell. This allows for regulation of what enters and exits the cell.

10. Saturated is to single bond as unsaturated is to double bond.

11. What functional groups are found in lipids, such as the one found to the right? Circle and identify each group. hydroxyl groups



12. What is the name of the bond indicated by the arrow in the lipid above?
ester linkage/ester bond

13. What type of fatty acid is shown in the lipid above? unsaturated

14. How would a polyunsaturated fatty acid differ? more than one double bond in the fatty acid chain.

15. How would a saturated fatty acid differ? only single bonds between the carbons in the fatty acid chains

16. If the lipid above was a triglyceride, how many fatty acids would be linked to the glycerol? 3

17. If the lipid above was a phospholipid, how many fatty acids would be linked to the glycerol and what additional group(s) would be present in the molecule? 2 fatty acids, 1 phosphate group is added

18. What type of reaction would occur to link each fatty acid to the glycerol? anabolic/condensation reaction /dehydration synthesis

19. List the different types of lipids and state each of their functions.
triclyceride – energy storage & insulation
phohpholipid – cell membranes
steroid – cell signalling & messaging
wax – protecive coating

20. When a person goes on a diet, stored lipids begin to be digested. What happens chemically when the lipids are digested (broken down)? fatty acids are broken down
What is the name given to this process? catabolic /hydrolysis reactions

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Proteins

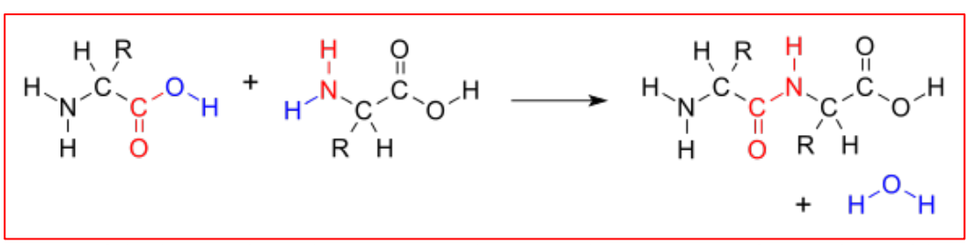
21. Why can a protein be called a polypeptide but a polypeptide cannot be called a protein?

A polypeptide is just a string of amino acids. A protein has a definite structure. A polypeptide is the first (primary) stage required in making proteins. Molecules are not considered proteins until they have a definitive shape, which occurs in their tertiary structure.

22. Explain how the 3-dimensional shape of proteins is formed.

Hydrogen bonding occurs between side chains of amino acids to form alpha-helixes and beta-pleated sheets in the secondary structure. Then the molecule interacts with the environment, hydrophobic molecules go to inside, hydrophilic move towards outside, acids and bases pair together due to charges and disulfide bonds occur to make tertiary structure.

23. Use a diagram to show how a peptide bond is formed between two amino acids.



24. Discuss some of the interactions that can occur between the R groups of an amino acid sequence.

acidic (+) and basic (-) amino acids will group together, hydrogen bonding will occur between polar/hydrophilic side chains forming alpha-helixes and beta-pleated sheets.

25. Some features of amino acids are common while others are not. Explain

There are many hydrophilic and hydrophobic amino acids, but only 2 acids and 3 bases. Cytosine is the only amino acid to contain sulfur.

26. How does having different R groups make amino acids ideal building blocks for proteins?

There are many ways they can interact with each other and their environments allowing for amny different shapes which leads to many different functions.

27. Why are some amino acids soluble in water while others are not?

Depending on their side chains amino acids can be polar and will dissolve in water or non-polar and not dissolve in water.

28. Name three functions of proteins in a living organism.

enzymes – speed up reactions

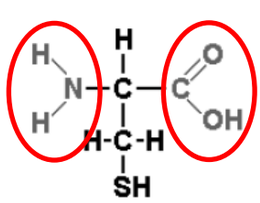
cell surface markers – antigens

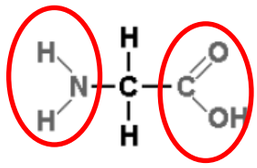
structural support - cytoskeleton

29. Which elements are found in proteins but in neither carbohydrates nor lipids.

Sulfur, nitrogen

30. What type of compound is shown to the right? amino acid





31. What functional groups are present in both of the compounds found in question 30? amino, carboxyl
Circle and label all of the functional groups visible.

32. Describe what would have to occur to link the two compounds together. What substance is removed (produced)? anabolic reaction leading to a peptide bond between the N of one and the C of the other amino acid. Water would also be produced.

33. What is the name of the bond this is formed between these two compounds? peptide bond

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Nucleic Acids

34. Which element is found in nucleic acids but in neither carbohydrates nor proteins? Phosphorous

37. You connect a molecule of ribose, a phosphate, and a molecule of cytosine. What have you made?

nucleotide

38. What does a nucleotide consist or? pentose sugar (ribose / deoxyribose), nitrogenous base & phosphate

32. What are the five nitrogenous bases found in nucleic acids? guanine, cytosine, adanine, thymine (DNA only), uracil (RNA only)

33. Differentiate between DNA and RNA.
DNA – double stranded, deoxyribose sugar, A/T/C/G
RNA – single stranded, ribose sugar, A/U/C/G

34. What type of bonds hold the sugar phosphate backbone of DNA & RNA together? phosphodiester

35. What type of bonds hold the nitrogenous bases of DNA together? hydrogen

36. What is ATP? adenosine triphosphate – energy molecule for cells

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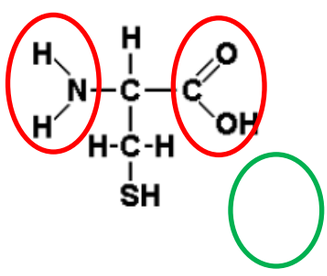
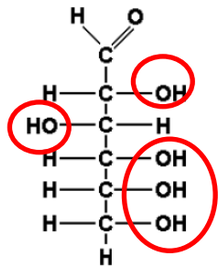
Macromolecules

37. Which organic compound(s)/macromolecules are the following functional groups associated with?
   a. Phosphate – nucleic acids
   b. Carboxyl - proteins
   c. Hydroxyl – carbohydrates

38. How many functional groups can you identify in the compound to the right? Circle and identify each group. amino on left, carboxyl on right

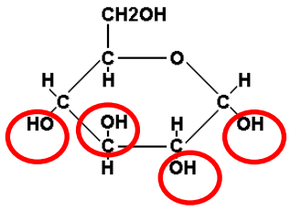


38. What is the name of the compound in question 39? straight chain glucose



39. What functional groups can you identify in the compound to the right? hydroxyl, **carboxyl** Circle and label them and then name the compound. glucose

40. What kind of organic compound is show to the right? carbohydrate What functional groups can you identify? Circle and label one of them.



41. Which of these things is not like the others? Why not?

(a) fiber (b) sugar (c) starch (d) cellulose (e) **fat**

The other molecules are all carbohydrates

42. Name the basic building blocks for each of the following molecules:

a) Protein amiono acids (b) Triglyceride glycerol & fatty acids

(c) Carbohydrate monosaccharides (d) Nucleic acids nucleotides

43. Proteins are to amino acids as polysaccharides are to monosaccharides .