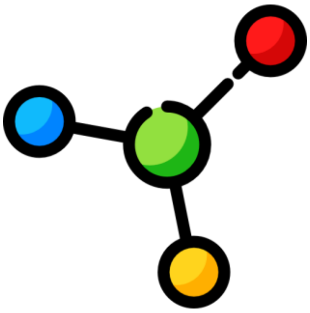
A LEVEL BIOLOGY REVISION

BIOLOGICAL MOLECULES
FACT FILE

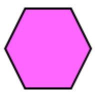
name:__________

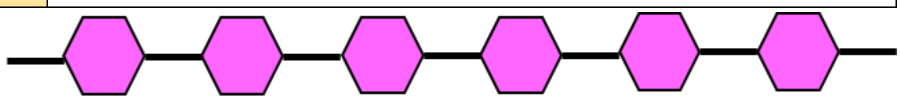


Spec point 2.1.2 (b)

MOLECULAR BONDING
THE BASICS

	Definition
Monomer	
Polymer	
Isomer	





Biological Molecule	Monomer	Polymer
Carbohydrate		
Proteins		
Nucleic Acids		
Biological Macromolecules	Constituent Parts:	
Phospholipid		
Triglyceride		

What happens in a condensation reaction?

What happens in a hydrolysis reaction?

Spec point 2.1.2 (a)

WATER

As water is a <u>liquid</u> at room temperature, what special things can it do?

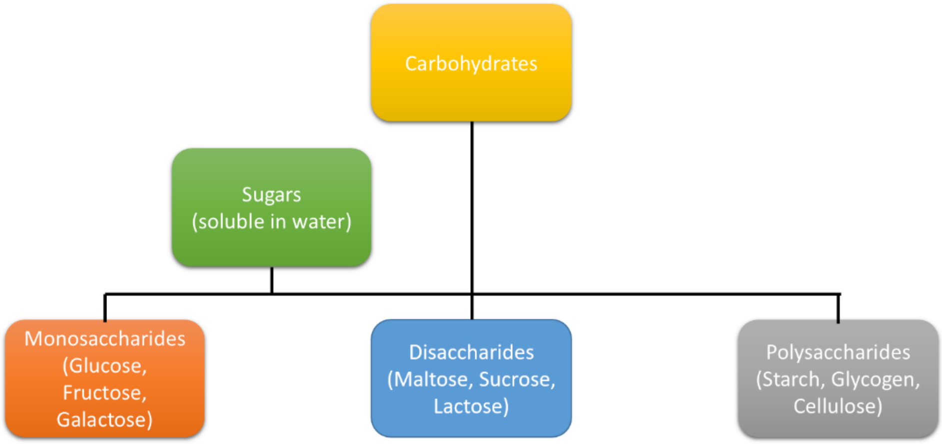
Draw and label a diagram of a water molecule including the bonds and charges involved:

Property of water demonstrated	Explanation of this property	How this property is demonstrated in prokaryotes and eukaryotes
Density		
Solvent		
Cohesion		
Surface Tension		
High specific heat capacity		
Latent heat of vaporisation (coolant)		
Reactant		

CARBOHYDRATES

Spec point 2.1.2 (d and e)

Carbohydrates are key biological molecules that **store energy** and can provide **structural support** to plant cells. Carbohydrates can be classified into three groups determined by how many units they are made of, as seen in the flow diagram below:



Monosaccharides

Monosaccharides are the **simplest** form of carbohydrates and are **sugars** that are **sweet** and **soluble** in water. Glucose is a hexose sugar with 2 isomers:

α-glucose	β-glucose
Structure:	Structure:
Role(s) in nature:	Role(s) in nature:

Disaccharides

Disaccharides are also **sweet** and **soluble** in water. The most common are shown below:

Disaccharides	Constituents	Reducing Sugar or Non-reducing Sugar?
Maltose		
Sucrose		
Lactose		

In the space below, draw 2 α-glucose molecules joining together.

What is the name of the bond that forms between 2 monosaccharides and what type of bond is this?

Carbohydrates (Polysaccharides) as an Energy Store

Polysaccharides are **polymers** of monosaccharides. Glucose molecules joined together to form a polysaccharide can create a store of energy.

In the space below, write down the formula for aerobic respiration:

Plants store energy as ___________ in chloroplasts and in membrane bound starch grains.

Humans store energy as _____________ in muscle cells and liver.

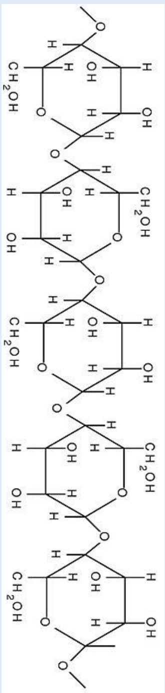
Complete the following table:

Polysaccharide	Detailed Structure	What makes this a good energy store?
Amylose		
Amylopectin		
Glycogen		

Carbohydrates (Polysaccharides) and their Structural Role

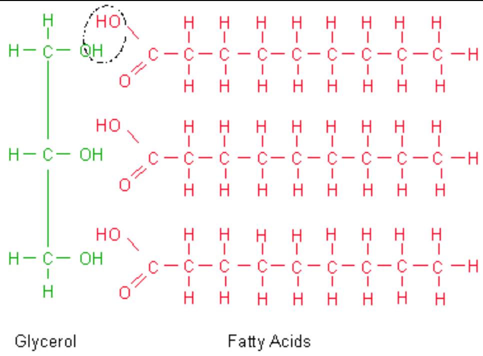
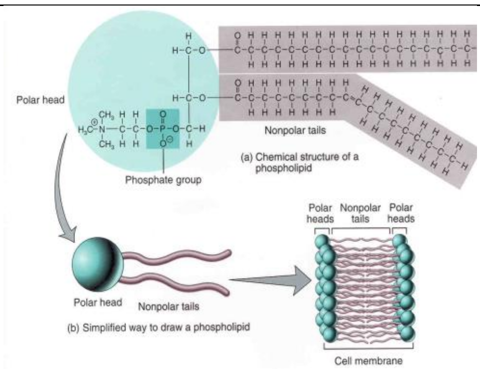
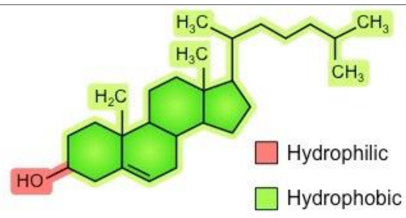
Cellulose is found in plants and forms the cell walls. It is a tough, insoluble and fibrous substance formed of many β-glucose molecules.

Complete the following:

	Structure and bonding	**How is it a perfect material for cell walls in plants?**
Cellulose 		

LIPIDS

Spec point 2.1.2 (h-j)

Lipid	Structure	Role(s) in living organisms	How does the structure help it perform its roles in living organisms?
Triglyceride	 1. *How are triglycerides formed?* 2. *What is the name of the bond formed in a triglyceride?* 3. *What is a saturated fatty acid and what does this mean for the triglyceride?*		
Phospholipid			
Cholesterol			

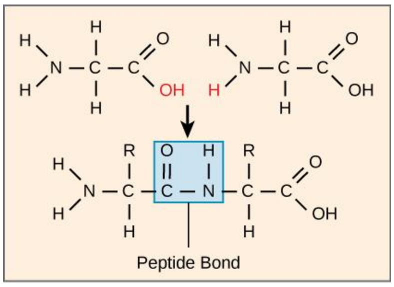
PROTEINS

In the space below, draw the general structure of an amino acid. Make sure you label and highlight the groups.

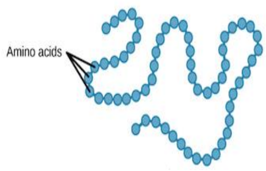
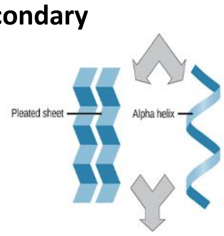
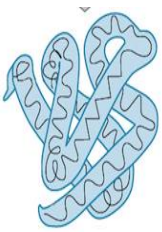
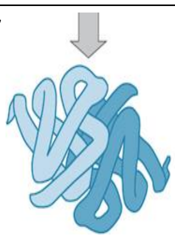
Protein Characteristics – Fill in the gaps with suitable words

- Proteins are **large** organic molecules made up of ______________ monomers to create long polypeptide chains.
- They contain Carbon, ________, __________, Nitrogen. (Some also contain Sulphur and Phosphorus).
- All proteins contain nitrogen and this makes them different to carbohydrates and ____________.
- Proteins make up about 18% of the body and about 66% of a cell.
- Different proteins have different _____________ and the shape is closely related to its function. Shape is particularly important if the protein is an enzyme.

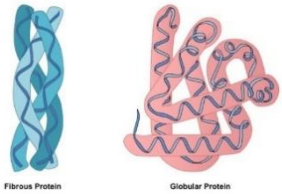
Describe what happens in the synthesis and breakdown of a dipeptide/ polypeptide:



The Levels of Protein Structure

Protein Level	Details about the structure:	Bonds involved:
Primary 		
Secondary 		
Tertiary 		
Quaternary 		

Fibrous vs Globular Protein



Read the passage below and use the information and your notes to complete the table.

Proteins can be divided into two distinct groups according to their overall shapes; fibrous or globular. The final protein doesn't have to be quaternary.

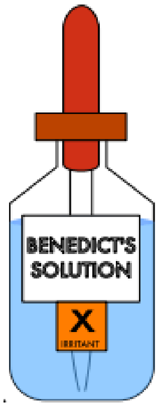
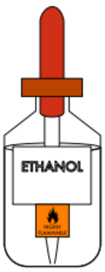
Fibrous proteins are insoluble in water and are very tough making them ideal for structural functions. They do not fold up into a ball shape but remain as long narrow strands or sheets with little to no tertiary structure. Fibrous proteins are also made from repeating amino acid sequences. This allows for several polypeptide chains to form cross-links for additional strength. In terms of properties, fibrous proteins are usually insoluble and less sensitive to changes in pH, temperature and salinity. They are found in collagen in bones, silk in spiders webs (β pleated), keratin (α helix) in hair and nails and elastin in skin.

In globular proteins the polypeptide chain is folded into a compact spherical shape due to their irregular pattern and sequence of amino acids. They have more complex tertiary and quaternary structures that are made soluble due to hydrophilic side chains that project from the outside of the molecules. Globular proteins are generally more sensitive to changes in pH, temperature and salinity.

Example: Enzymes- their 3D shape is crucial to their ability to form enzyme-substrate complexes and catalyse reactions within cells. The 3D shape is crucial to their roles in binding to other substances e.g. transport proteins in cell membranes, haemoglobin, antibodies (to bind to specific microorganisms).

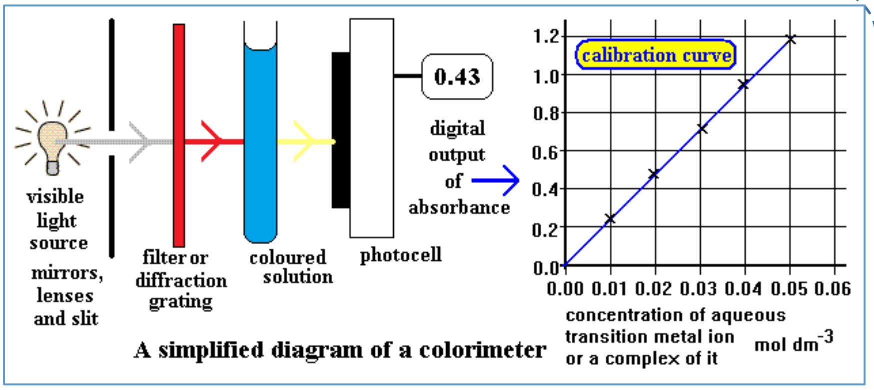
	Fibrous	**Globular**
Shape		
Purpose		
Amino acid sequencing		
Durability/ sensitivity		
Examples		
Solubility		

TESTING FOR BIOLOGICAL MOLECULES

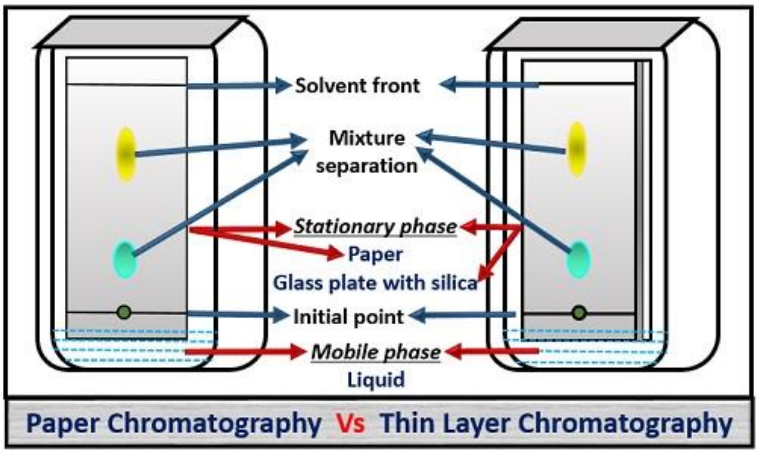
Testing Chemical	Biological Molecule testing for?	How to carry out the test?	Positive test result	Negative test result
				
				
				
				
Glucose Test Strips: 				

Quantitative Tests for Biological Molecules

How can we use a colorimeter to quantitatively test for reducing sugars? What is a calibration curve?



Thin Layer Chromatography (TLC)



1) What is the aim of TLC?

2) What is the stationary phase in TLC?

3) What is the mobile phase in TLC?

4) What happens as the solvent travels up the plate in TLC? How does this work?

5) What formula do we use to calculate the distance travelled in the TLC plate and therefore help you identify pigments?

6) With colourless molecules, it is difficult to see where they finish. How can the three solutions below be used to help make these molecules identifiable?:

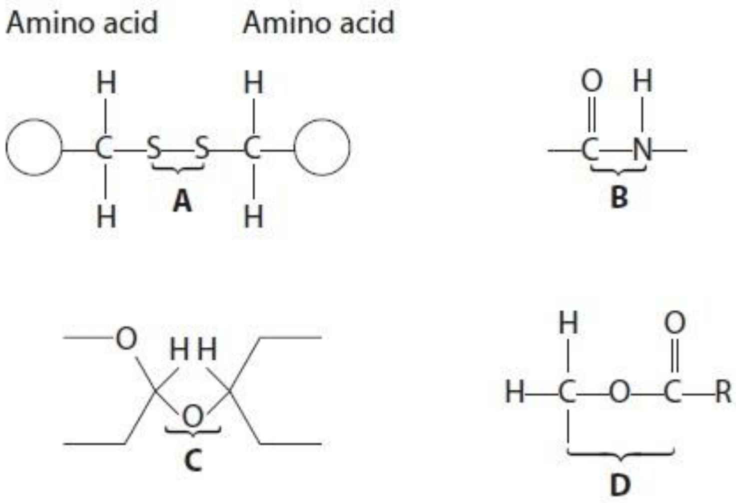
   a. Ultraviolet Light:

   b. Ninihydrin:

   c. Iodine:

Practice questions

Q1. The diagrams below show four different bonds, A, B, C, and D, found in biological molecules.



Place a cross ☒ in the box to complete each of the following statements.

(i) The bond which occurs in a triglyceride molecule is

(1)

☐ **A**

☐ **B**

☐ **C**

☐ **D**

(ii) The bond which may occur in the tertiary, but not the primary, structure of a protein is

(1)

☐ **A**

☐ **B**

☐ **C**

☐ **D**

(iii) The peptide bond is

(1)

☐ **A**

☐ **B**

☐ **C**

☐ **D**

(iv) The ester bond is

(1)

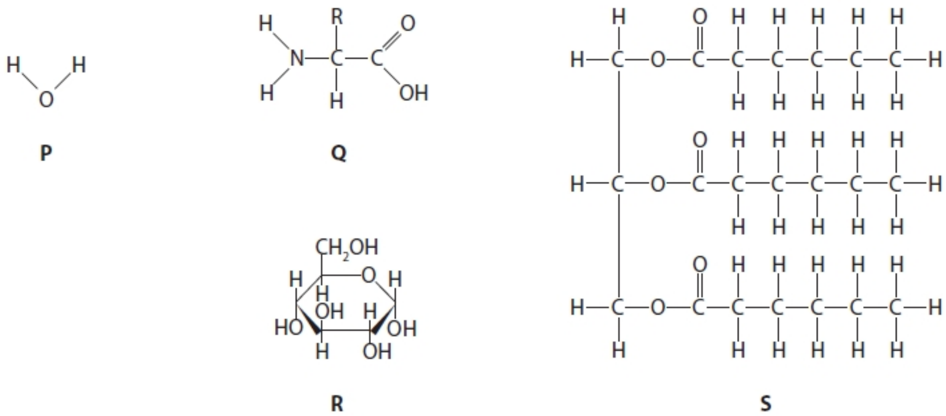
☐ **A**

☐ **B**

☐ **C**

☐ **D**

Q2. The diagram below shows four molecules, P, Q, R and S, found in living organisms.



Place a cross ☒ in the box to complete each of the following statements.

(i) Two molecules of **P** can be joined together by

(1)

☐ **A** a hydrogen bond

☐ **B** a hydrophobic interaction

☐ **C** an ionic bond

☐ **D** a peptide bond

(ii) A condensation reaction between two molecules of **Q** forms

(1)

- **A** an ester bond
- **B** a glycosidic bond
- **C** a hydrogen bond
- **D** a peptide bond

(iii) Molecule **R** is

(1)

- **A** a fatty acid
- **B** an amino acid
- **C** deoxyribose
- **D** glucose

(iv) One of the products of the hydrolysis of molecule **S** is

(1)

- **A** a triglyceride
- **B** an amino acid
- **C** glycerol
- **D** water

Q3.

Lysozyme is an enzyme found in tears. Lysozyme can destroy some bacteria by breaking down the polysaccharide chains that form part of their cell walls.

The primary structure of lysozyme is a specific sequence of 129 amino acids.

Two of the amino acids that make up the active site are in positions 35 and 52 in the primary structure.

Suggest how these two amino acids could be brought closer together to form part of the active site of this enzyme.

(3)

....

....

....

....

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....

....

Q4.

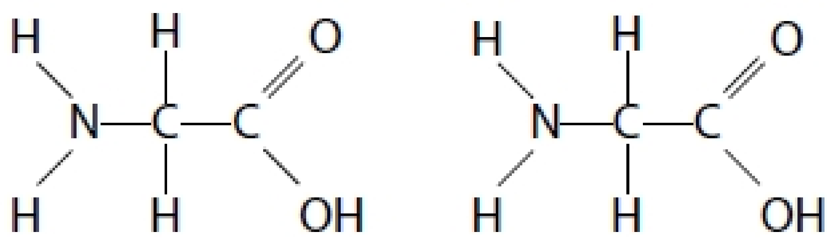
Proteins, such as collagen, are made from amino acids joined together.

(i) Which of the following is the name of the bond used to join amino acids together?

(1)

- ☐ **A** ester
- ☐ **B** glycosidic
- ☐ **C** peptide
- ☐ **D** phosphodiester

(ii) This diagram shows the structure of two amino acids that can be joined together by a reaction.



Draw a diagram to show the products of this reaction.

(2)

(iii) Which of the following is the R group in these amino acids?

(1)

☐ **A** COOH

☐ **B** NH_2

☐ **C** H

☐ **D** OH

Read the paragraph and fill in the gaps using your knowledge

Proteins are composed of long chains of monomers called ______________, which are linked together by ___________ bonds. These bonds are formed by ____________ reactions between adjacent monomers.

The ____________ structure of a protein is the specific __________ of monomers in a polypeptide chain and determines the secondary and tertiary protein structure.

The secondary structure of a protein may be a coil, known as an ____________ which is held in shape by ____________ bonds between different monomers in the chain. It may also be a folded structure called a ____________.

A _____________chain often bends and folds further to produce a precise three-dimensional shape. Chemical ___________ and hydrophobic interactions between R groups maintain this final ____________ structure of the protein.

Proteins can be divided into two distinct groups according to their overall __________: __________and _________ proteins.

Self assessment of exam questions and gap fill			
Total:	/29	%	Grade:
Target:			

Mark scheme:

Question 1:

Question Number	Answer	Mark
(a)(i)	D ;	(1)

Question Number	Answer	Mark
(a)(ii)	A ;	(1)

Question Number	Answer	Mark
(a)(iii)	B ;	(1)

Question Number	Answer	Mark
(a)(iv)	D ;	(1)

Question 2:

Question Number	Answer	Mark
(i)	A a hydrogen bond ;	(1)

Question Number	Answer	Mark
(ii)	D a peptide bond ;	(1)

Question Number	Answer	Mark
(iii)	D glucose ;	(1)

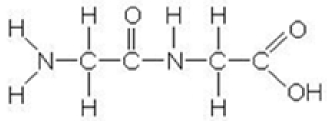
Question Number	Answer	Mark
(iv)	C glycerol ;	(1)

Question 3:

Question Number	Answer	Additional Guidance	Mark
	1. idea of formation of secondary or tertiary structure ;	1. **ACCEPT** e.g. alpha helix, beta pleated sheet, globular structure **ACCEPT** folding (of primary structure) **IGNORE** 3D shape	(3)
	2. idea of bonding between R groups ;	2. **ACCEPT** hydrophilic R groups go to outside/ hydrophobic R groups go to inside / eq	
	3. named bond e.g. ionic, disulfide, hydrogen ;	3. **DO NOT ACCEPT** peptide	

Question 4:

Question Number	Acceptable Answer	Additional guidance	Mark
(i)	C		(1)

Question Number	Acceptable Answer	Additional guidance	Mark
(ii)	water molecule indicated (1)  correct dipeptide shown (1) 		(2)

Question Number	Acceptable Answer	Additional guidance	Mark
(iii)	C		(1)

Question 5:

Proteins are composed of long chains of monomers called amino acids, which are linked together by peptide bonds. These bonds are formed by condensation reactions between adjacent monomers.

The primary structure of a protein is the specific sequence of monomers in a polypeptide chain and determines the secondary and tertiary protein structure.

The secondary structure of a protein may be a coil, known as an **α** helix which is held in shape by hydrogen bonds between different monomers in the chain. It may also be a folded structure called a **β** pleated sheet.

A polypeptide chain often bends and folds further to produce a precise three-dimensional shape. Chemical bonds and hydrophobic interactions between R groups maintain this final tertiary structure of the protein.

Proteins can be divided into two distinct groups according to their overall shapes: globular and fibrous proteins.