# 2.2 Carbohydrates & Lipids

## Mark Schemes

| | |
|---|---|
| Course | DP IB Biology |
| Section | 2. Molecular Biology |
| Topic | 2.2 Carbohydrates & Lipids |
| Difficulty | Medium |



To be used by all students preparing for DP IB Biology HL
Students of other boards may also find this useful

1

The correct answer is **C** because **molecule 1** is a triglyceride and the skeletal formula of the fatty acid chains shows no double bonds within the fatty acid chains. By contrast, in **molecule 2** (a phospholipid) we can clearly see a double bond in the fatty acid chain on the right.

**A** is incorrect as the statement about **molecule 1** is correct but the statement about **molecule 2** is incorrect – the phospholipid has one unsaturated fatty acid.

**B** is incorrect as **molecule 1** has three **ester bonds** linking the fatty acid chains to the glycerol 'head'; glycosidic bonds are found in carbohydrates, not lipids. **Molecule 2** has two fatty acid chains attached via ester bonds to a glycerol molecule, and a phosphate ester bond between the glycerol and phosphate group.

**D** is incorrect as **molecule 1** is non-polar whereas **molecule 2** is polar.

2

The correct answer is **D** because polysaccharides are generally insoluble in cold water.



Amylose and amylopectin (30% and 70% of starch) are both polymers of α-glucose. α-glucose dissolves readily in water, so if it accumulated in cells it would decrease the osmolarity (making the cell more concentrated) which would seriously affect the osmotic properties of the cell.

Answer **A** and **B** are incorrect as hydrolysis reactions result in the breakdown of amylose and amylopectin, condensation results in their formation.

Answer **C** is incorrect as amylose has a coiled, unbranched structure whereas amylopectin is branched (due to the presence of **1,6-glycosidic bonds**).

3

The correct answer is **B** because the only polysaccharide with **β-1,4 glycosidic bonds** is **cellulose**. This is formed from **β-glucose** molecules where every alternate glucose is rotated about 180° relative to its neighbours. The –$CH_2OH$ group that is attached to $^5C$ projects in an alternating pattern on each side of the polysaccharide chain.

**A, C** and **D** are all polysaccharides of α-glucose, where the $CH_2OH$ always projects **upwards** relative to $^5C$. Amylose is unbranched, like cellulose, but its structure is coiled unlike cellulose and it contains **α-1, 4 glycosidic bonds**.

4

The correct answer is **B.**

The only difference between the structure of **α-glucose** and **β-glucose** is the arrangement of the OH and H groups attached to the first carbon on the glucose molecule. For **β-glucose**, the rule for the OH group placement from $^1C$ to $^4C$ is 'up-down-up-down', whereas for **α-glucose** is the rule 'down-down-up-down'.

5



The correct answer is **C** because a triglyceride is not classified as a polymer; it is not made from **many** smaller repeating subunits. In comparison, a polysaccharide such as cellulose is a biological polymer as it is formed from chains of thousands of glucose molecules joined together by covalent bonds. Triglycerides are made from three fatty acid chains joined to a glycerol molecule, so they **are** composed of smaller subunits

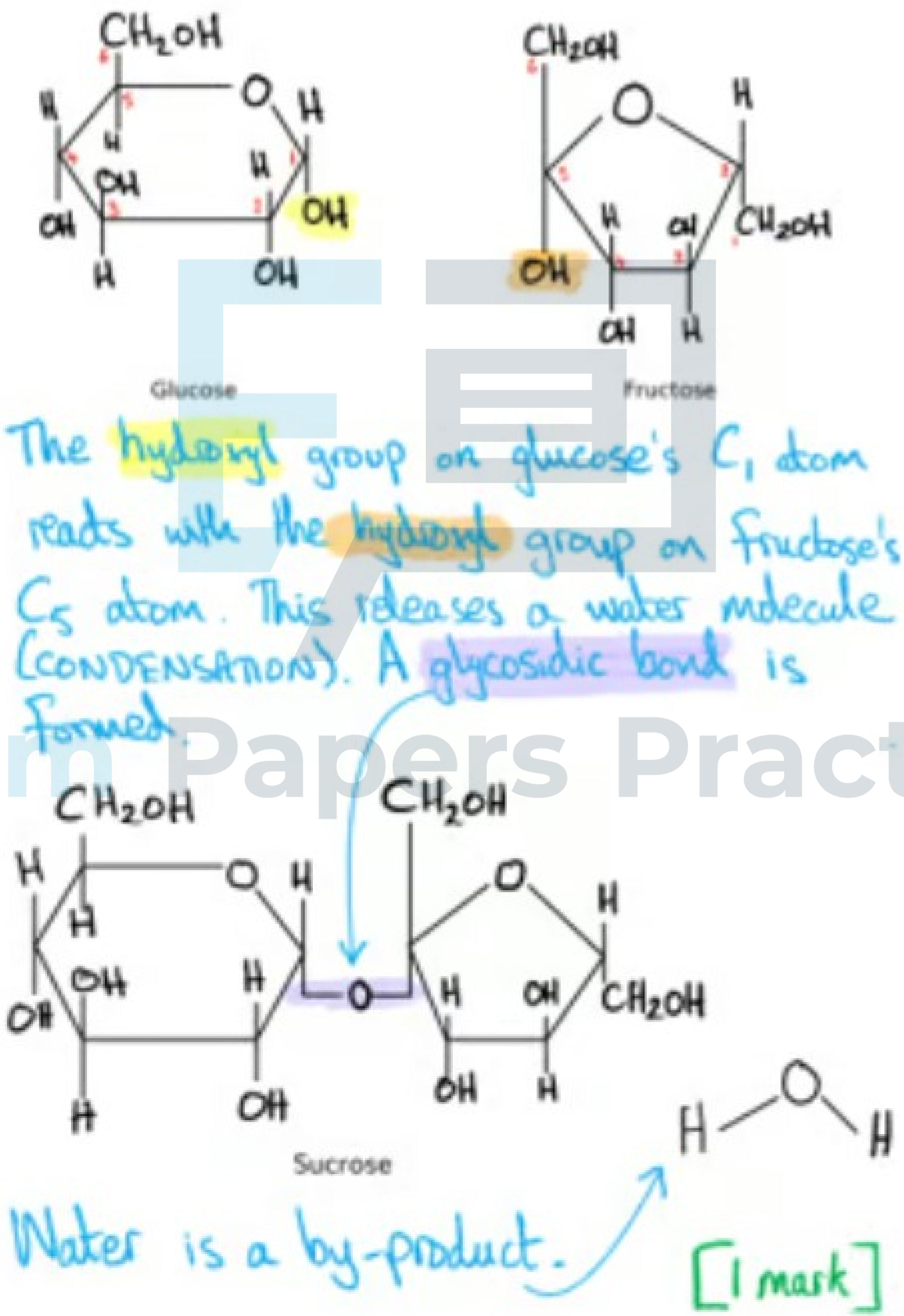
**A** is incorrect as glycosidic bonds form during condensation reactions, not hydrolysis reactions.

**B** is incorrect as a triglyceride is formed from smaller subunits joined together.

**D** is incorrect as glycosidic bonds join monosaccharides together to form disaccharides and polysaccharides.

6

The correct answer is **C** because sucrose is a disaccharide that forms when two monosaccharides, glucose and fructose, are chemically bonded together.




**B** and **D** are incorrect because glucose and galactose combine to form a different disaccharide, lactose.

7

The correct answer is **B** because cis-fatty acids have a hydrogen atom at either end of a carbon-to-carbon double bond, and these H-atoms sit on the same side of the hydrocarbon chain. In trans-fatty acids, the two hydrogens sit on opposite sides of the hydrocarbon chain.

**A** is incorrect because cis-fatty acids and trans-fatty acids are isomers and are both types of **unsaturated** fatty acid.

**C** is incorrect because trans-fatty acids have a straighter structure, so they can pack closer together.

**D** is incorrect because cis-fatty acids are kinked, trans-fatty acids are straight.

8

The correct answer is **D** because a small number of fatty acids (but not whole lipids) play a role in regulation of gene expression. The question asks specifically about **whole** lipids.

**A** is not correct because a layer of protective fat forms around many vulnerable internal organs eg. visceral fat around the heart.



**B** is not correct because seals and other marine creatures use fat for insulation and flotation (fat is generally less dense than water).

**C** is not correct because many fats carry fat-soluble nutrients (eg. certain vitamins) through the digestive system.

9

The correct answer is **B** because it contains hydrogen in an atom ratio of 2:1 with oxygen. 32 hydrogen atoms and 16 oxygen atoms = 2:1 ratio.

**A** and **C** are incorrect because they contain a lot fewer oxygen atoms in relation to hydrogen atoms (these are in fact lipids).

**D** is incorrect because it does not contain hydrogen to oxygen in a 2:1 ratio either (this is in fact glycerol).

10

The correct answer is **A** because lipids containing trans-fats tend to form solids at room temperature which makes them more appealing to consumers as they are drier and less 'greasy' in appearance.

**B** is incorrect because trans-fats are a well-known risk factor for coronary heart disease, as well as many other illnesses.

**C** is incorrect because this wording gets around the fact that these fats are not fully hydrogenated.

**D** is incorrect because trans-fats are favoured in food manufacture for this reason.