

# Biological Molecules

## Multiple Choice

### Model Answers 1

Level	A Level
Subject	Biology
Exam Board	OCR
Module	Foundations in Biology
Topic	Biological Molecules
Booklet	Model Answers 1

**Time allowed:** 23 minutes

**Score:** /17

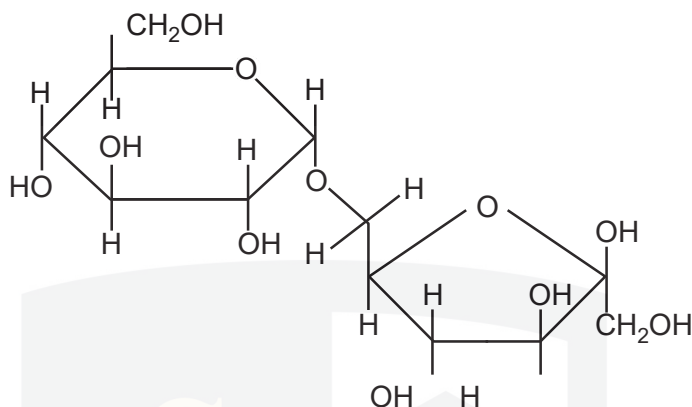
**Percentage:** /100

**Grade Boundaries:**

A*	A	B	C	D	E
>69%	56%	50%	42%	34%	26%

## Question 1

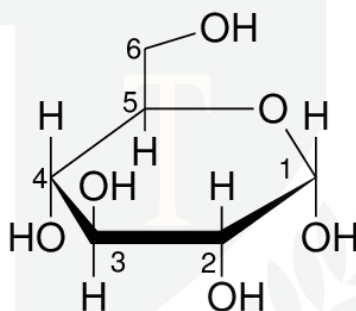
The image below shows isomaltulose, a disaccharide formed from  $\alpha$ -glucose and fructose.



Name the bond that holds the  $\alpha$ -glucose and the fructose together.

[1]

- A** 1,6-glycosidic bond
- B** phosphodiester bond
- C** ester bond
- D** 1,4-glycosidic bond




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## Question 2

The hydroxyl (-OH) group of carbohydrates is polar and makes the molecule soluble in water. The greater the number of free hydroxyl groups as a proportion of the number of carbon atoms, the more soluble the carbohydrate.

[1]

Which of the rows, **A** to **D**, lists the carbohydrates in order of most soluble to least soluble?

	Most soluble			Least soluble
<b>A</b>	glucose	ribose	amylose	Amylopectin
<b>B</b>	amylose	amylopectin	glycogen	ribose
<b>C</b>	glucose	ribose	amylopectin	amylose
<b>D</b>	ribose	amylose	glucose	amylopectin

Glucose is the most soluble so that narrows it down to A and C

Amylopectin is the least soluble carbohydrate

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### Question 3

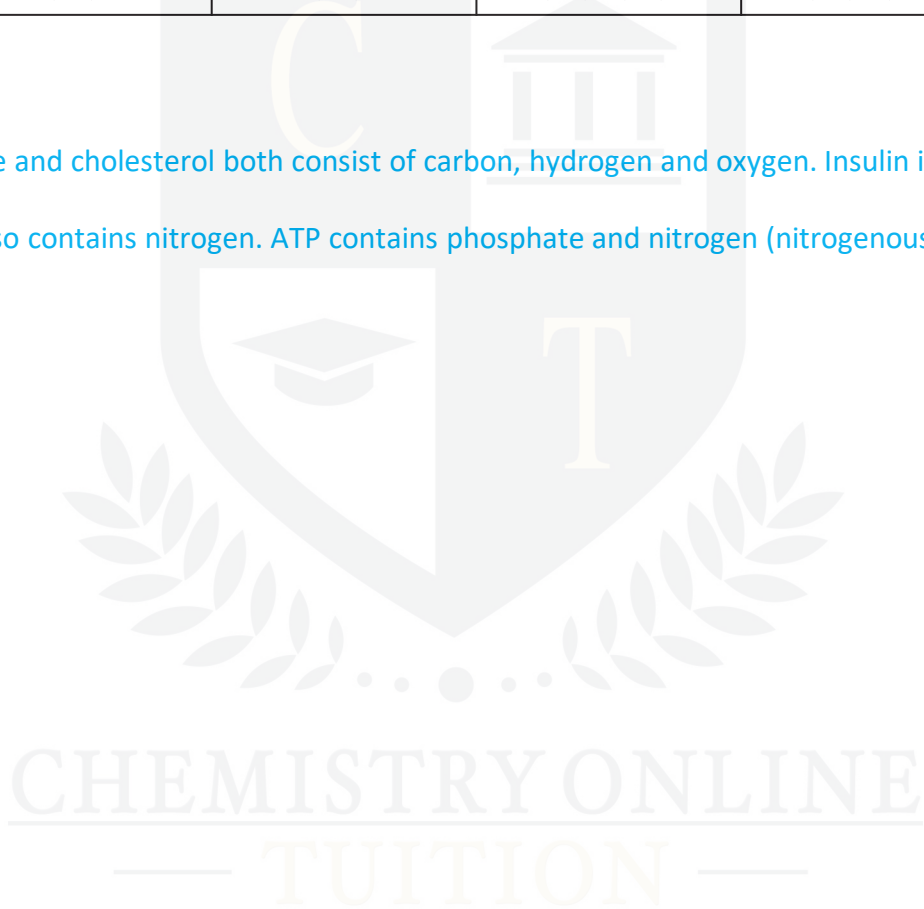
The table below shows four biological molecules and their component elements.

Which of the rows, **A** to **D**, correctly identifies the elements in each molecule?

[1]

	sucrose	cholesterol	insulin	ATP
<b>A</b>	C, H, O	C, H, O, N	C, H, O, N, S	C, H, O, N, P
<b>B</b>	C, H, O, N	C, H, O	C, H, O, N, S	C, H, O, N, S
<b>C</b>	C, H, O	C, H, O	C, H, O, N, S	C, H, O, N, P
<b>D</b>	C, H, O	C, H, O	C, H, O, N, P	C, H, O, N, P

Sucrose and cholesterol both consist of carbon, hydrogen and oxygen. Insulin is a protein so it also contains nitrogen. ATP contains phosphate and nitrogen (nitrogenous base)





## Question 4

The following are a series of organic molecules and the chemical processes that occur to convert them into different molecules.

Which of the rows, **A** to **D**, is correct?

**A** nucleic acid  $\xrightarrow{\text{hydrolysis}}$  nucleotide  $\xrightarrow{\text{hydrolysis}}$  polynucleotide

**B**  $\alpha$ -glucose  $\xrightarrow{\text{condensation}}$  amylopectin  $\xrightarrow{\text{hydrolysis}}$   $\alpha$ -glucose

**C** amino acid  $\xrightarrow{\text{condensation}}$  dipeptide  $\xrightarrow{\text{hydrolysis}}$  polypeptide

**D**  $\beta$ -glucose  $\xrightarrow{\text{condensation}}$  cellulose  $\xrightarrow{\text{condensation}}$  maltose

[1]

Condensation reactions join molecules together to make polymers

Hydrolysis splits the bonds to break polymers into monomers

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## Question 5

The following table describes the approximate percentage mass of different chemical elements in organic polymers.

	Polymer	N (%)	C (%)	O (%)	H (%)	P (%)
<b>A</b>	nucleic acid	20.0	30.0	20.0	10.0	20.0
<b>B</b>	carbohydrate	0.0	33.3	33.3	33.3	0.0
<b>C</b>	protein	30.0	10.0	10.0	0.0	50.0
<b>D</b>	lipid	0.0	50.0	49.0	1.0	0.0

Which of the rows, **A** to **D**, is correct?

[1]

Nucleic acids include all the elements C,H,O,N,P

Carbohydrates have C,H and O in the proportions 1:2:1

Proteins contain C,H and O and do not contain phosphorus

Lipids have MUCH more hydrogen (highly reduced)

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## Question 6

Which of the following processes involves the formation of ester bonds?

1 synthesis of polynucleotides

2 synthesis of triglycerides

3 synthesis of polypeptides

A. 1, 2 and 3

B. Only 1 and 2

C. Only 2 and 3

D. Only 1

[1]

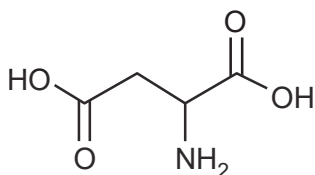
Fatty acids and glycerol are joined by ester bonds and sugars / phosphates in DNA and RNA are joined by phosphodiESTER bonds

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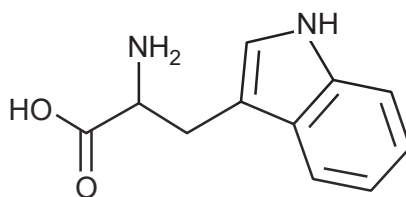
## Question 7

Which of the following could **not** be an amino acid?

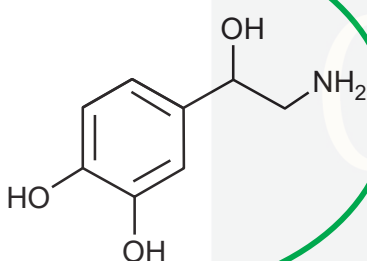
A



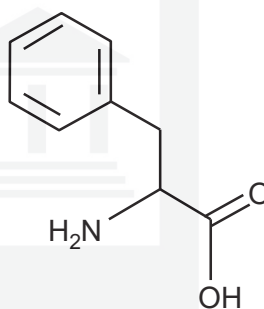
B



C



D



[1]

All amino acids have an amino group ( $\text{-NH}_2$ ) and a carboxyl group  $\text{-COOH}$ . The circled answer does not have a carboxyl group

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## Question 8

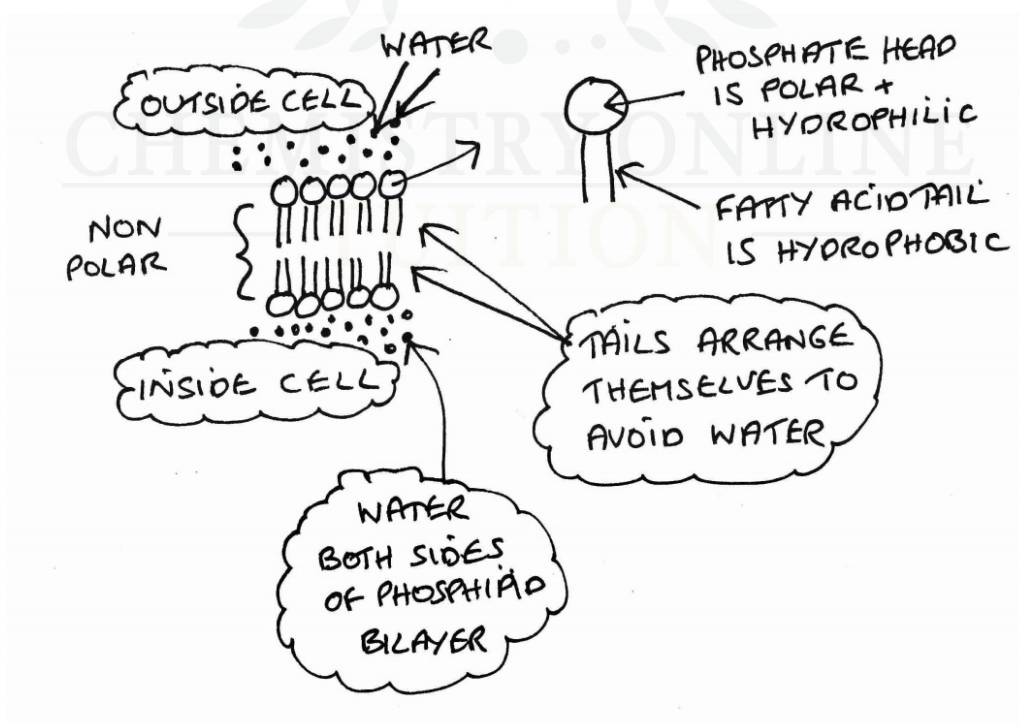
Lipids are a diverse group of chemicals that are neither polar nor charged and hence are insoluble in water. The \_\_\_\_ (1) \_\_\_\_ nature of the heads of phospholipids allows them to form membranes. \_\_\_\_ (2) \_\_\_\_ also contain fatty acids and form part of the membrane. Lipids can be used for energy storage in the form of \_\_\_\_ (3) \_\_\_\_\_. Some hormones are also lipids and they are similar in structure to \_\_\_\_ (4) \_\_\_\_\_.

Which row shows the correct sequence of missing words?

	1	2	3	4
A	hydrophilic	glycolipids	triglycerides	cholesterol molecules
B	hydrophilic	triglycerides	cholesterol molecules	glycolipids
C	hydrophobic	cholesterol molecules	triglycerides	bile
D	hydrophilic	cholesterol molecules	triglycerides	glycolipids

[1]

Phospholipids have a polar 'head' which is attracted to water hence the term hydrophilic, the non polar hydrocarbon 'tail' repels water and is described as hydrophobic

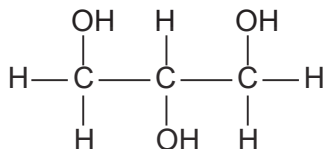


## Question 9

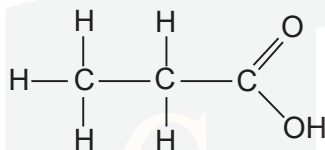
Water is known as the universal solvent as it has the ability to dissolve many ionic and covalent compounds due to its polar nature.

Which of the 3-carbon compounds will **not** form hydrogen bonds with water and will therefore **not** dissolve in water?

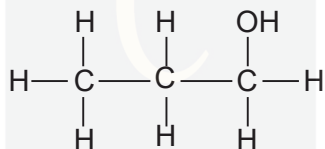
**A** glycerol



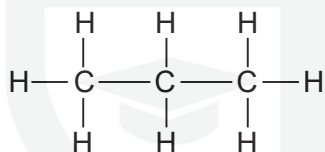
**B** propanoic acid



**C** propanol



**D** propane



[1]

Propane cannot dissolve in water as it is not a polar molecule. It doesn't contain a H bonded to an O - remember that oxygen is electronegative; it attracts electrons towards itself in an O-H leaving the H with a slightly positive charge. Water molecules contain O and H's that behave in the same way, so slightly positive H's attract slightly negative O's between both water molecules and molecules A, B and C.

## Question 10

Which of the options, **A** to **D**, is a correct statement about polysaccharides of glucose?

- A. Cellulose microfibrils are formed by hydrogen bonding between adjacent chains of  $\alpha$ -glucose molecules bonded with 1,4-glycosidic bonds.
- B. Amylose is a straight chain of  $\alpha$ -glucose monomers bound by 1,6-glycosidic bonds to allow for dense packing.
- C. Glycogen has a high proportion of 1,6-glycosidic bonds to produce a highly branched molecule for rapid release of  $\alpha$ -glucose.
- D. Amylopectin has a mixture of 1,4-glycosidic and 1,6-glycosidic bonds between  $\beta$ -glucose molecules for rapid release of energy.

[1]

Cellulose is made from  $\beta$  glucose in a straight chain of 1,4

Amylopectin is branched so contains 1,4 and 1,6 bonds with  $\alpha$  glucose

Amylose is a straight chain so must have  $\alpha$  1,4 glycosidic bonds

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## Question 11

A group of students was given a 1% solution of an unknown digestive enzyme.

They were also given three tubes containing an identical mixture of foods.

The students carried out a different biochemical test on each tube before and after adding the unknown enzyme. Their results are shown in the table below.

	Colour before	Colour after
<b>Biuret test</b>	purple	purple
<b>Iodine test</b>	blue / black	yellow / orange
<b>Benedict's test</b>	brick red	brick red

Name the type of enzyme the students used.

- A. protease
- B. carbohydrase**
- C. lipase
- D. cellulase

[1]

Biuret test is for protein and as it stays purple the protein is unaffected.

Benedict's test is for reducing sugar and changes from blue to brick red/yellow orange.

Iodine test is for starch which changes from orange to blue/black. Because the iodine test starts positive then becomes negative. the starch must have been digested by a carbohydrase

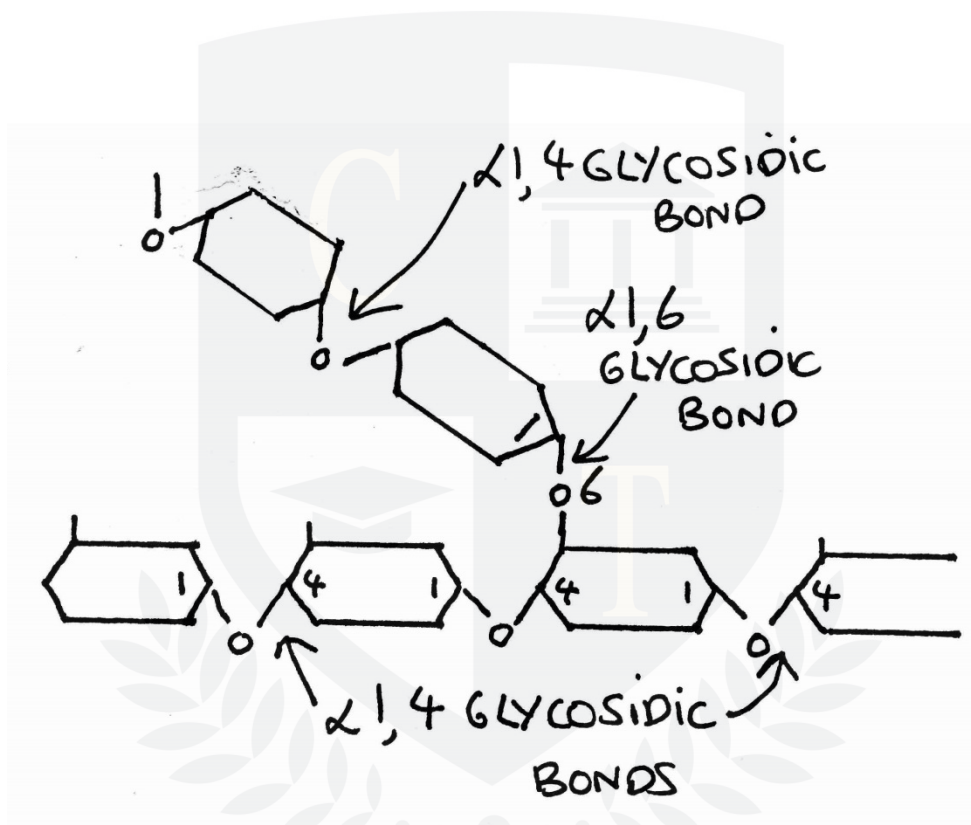


## Question 12

Which of the statements, **A** to **D**, about amylopectin is correct?

- A. it contains 1-4 and 1-6 glycosidic bonds between  $\alpha$ -glucose monomers
- B. it is an unbranched chain of  $\alpha$ -glucose monomers
- C. it contains  $\alpha$  1-4 and  $\beta$  1-6 glycosidic bonds
- D. it is made up of  $\beta$ -glucose monomers and is uncoiled

[1]



The solubility or adsorption are similar / both are more soluble than Y

If a substance is more soluble in a solvent and has less adsorption to the surface then it will be carried further along with the solvent

### Question 13

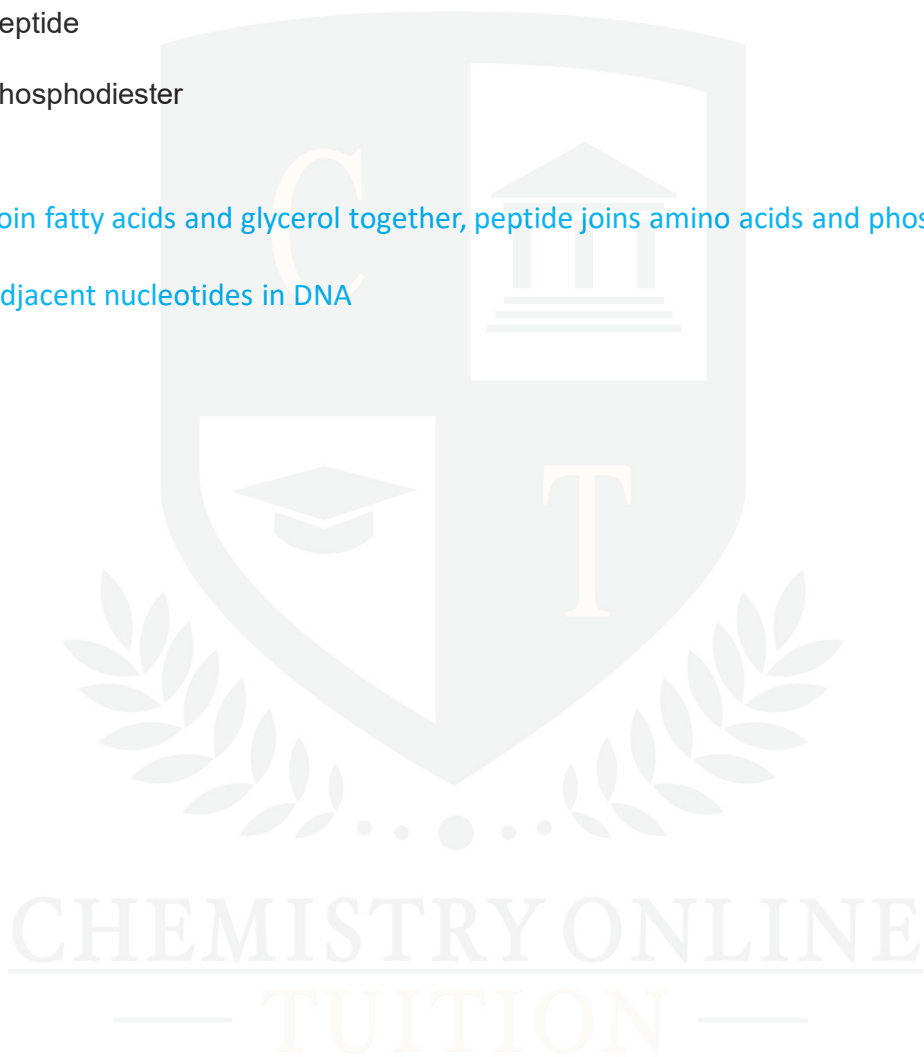
Carbohydrates, such as starch, are made from monosaccharides joined together.

Which of the bonds, **A** to **D**, joins monosaccharides together?

- A. ester
- B. glycosidic
- C. peptide
- D. phosphodiester

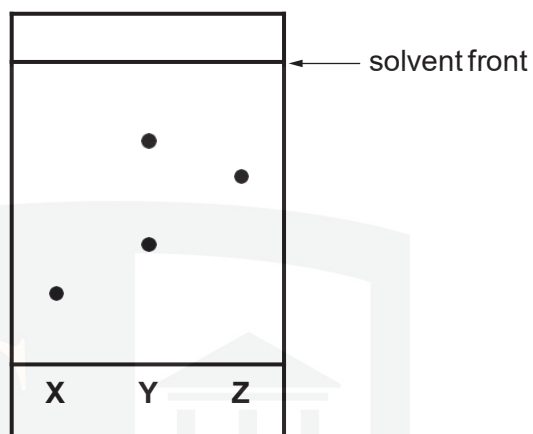
[1]

Ester join fatty acids and glycerol together, peptide joins amino acids and phosphodiester joins adjacent nucleotides in DNA



## Question 14

A student investigates some solutions, **X**, **Y** and **Z**, using paper chromatography. The results are shown below.



Which of the following options, **A** to **D**, is the  $R_f$  value of **Z**?

**A** 0.63

**B** 1.6

**C** 0.85

**D** 0.25

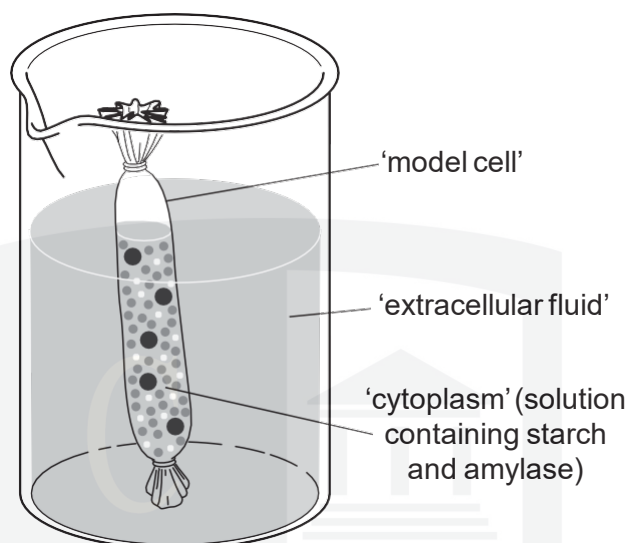
[1]

The  $R_f$  value is the distance moved by the spot divided by the solvent front distance

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## Question 15

A group of students were investigating the diffusion of molecules across membranes using a 'model cell', as shown below.



Biochemical tests were used to identify the types of molecules present. The results are shown in the table below.

A tick (✓) represents a positive result.

Which of the rows, **A** to **D**, shows the correct results for the 'cytoplasm' at the beginning of the experiment **and** the 'extracellular fluid' at the end of the experiment?

	Benedict's test		Biuret test		Iodine test	
	'cytoplasm'	'extracellular fluid'	'cytoplasm'	'extracellular fluid'	'cytoplasm'	'extracellular fluid'
<b>A</b>			✓		✓	
<b>B</b>		✓	✓	✓	✓	
<b>C</b>	✓	✓			✓	✓
<b>D</b>	✓		✓		✓	

The benedict's test is for reducing sugar hence the negative results for cytoplasm at the start, however if you waited long enough, starch in the cytoplasm would be digested by the enzyme amylase to sugars which would diffuse out. The enzyme amylase in the cytoplasm would give a positive result for protein (Biuret) which is too big to leave the model. The positive test for starch inside the model cell is obvious and outside remains negative as starch is too big to leave. Eventually the starch inside the model cell would be digested

## Question 16

Which of the following formulae of fatty acids represents a saturated fatty acid?

**Statement 1:** Palmitic acid,  $C_{15}H_{31}COOH$

**Statement 2:** Oleic acid,  $C_{17}H_{33}COOH$

**Statement 3:** Linoleic acid,  $C_{17}H_{31}COOH$

**A** 1, 2 and 3

**B** Only 1 and 2

**C** Only 2 and 3

**D** Only 1

[1]

the ratio of C's in the backbone of the chain to H's and the one COOH group is 15:32 for palmitic acid which is  $2n+2$  suggesting it is a saturated acid, the other two do not obey  $2n+2$  (oleic acid has 17 C's and 33+1 (for H's and the COOH) group, and linoleic has 17C's and only 31+1 (for H's and the COOH

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## Question 17

An unknown solution of a single sugar was tested. The results were recorded in **Table 9.1**.

Colours observed after testing	
Benedict's test for reducing sugars	Benedict's test for non-reducing sugars
blue	brick red

**Table 9.1**

Identify the unknown sugar.

- A. fructose
- B. lactose
- C. sucrose
- D. glucose

[1]

Sucrose is a non reducing sugar so is negative with Benedict's and stays blue. For non reducing sugars the first step involves boiling with dilute acid, this hydrolyses the disaccharide into two monosaccharide, reducing sugars

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