CAMBRIDGE INTERNATIONAL AS & A LEVEL BIOLOGY · 9700

BIOLOGY



EXAM QUESTION PACK

2 BIOLOGICAL MOLECULES

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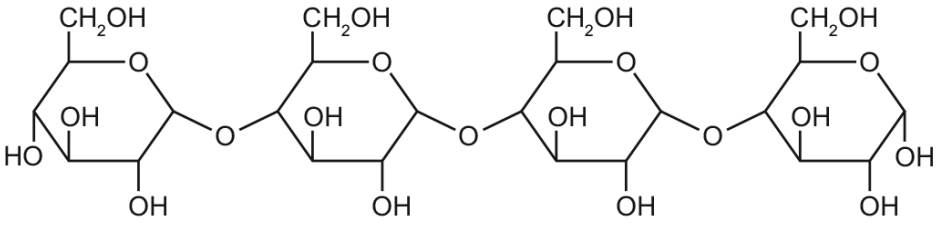
Chapter 2

Biological molecules

2.1 Testing for biological molecules

216. 9700_m20_qp_12 Q: 7

The molecule shown is a polymer of reducing sugars.



Which procedures could be carried out to show that this molecule is a polymer of reducing sugars?

1 Add hydrolytic enzyme and then heat with Benedict's solution.

2 Dissolve in water, neutralise and then heat with Benedict's solution.

3 Boil with hydrochloric acid, neutralise and then heat with Benedict's solution.

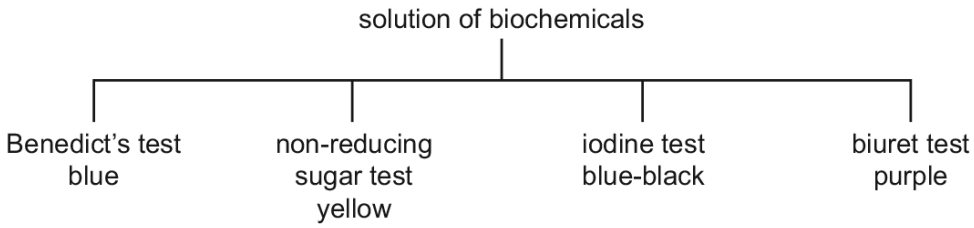
A 1, 2 and 3 **B** 1 and 2 only **C** 1 and 3 only **D** 2 and 3 only

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217. 9700_s20_qp_11 Q: 6

The flow diagram shows the results of a number of tests on a solution of biochemicals.



Which substances are present in the solution?

A amylose, amylopectin and lipid

B glucose, starch and catalase

C sucrose, amylase and triglyceride

D sucrose, starch and catalase

---

218. 9700_s20_qp_12 Q: 7

A student carried out the Benedict's test on a sample and got a negative result.

What should the student do to confirm there are no sugars present in the sample?

A boil the sample for 5 minutes then repeat the Benedict's test

B boil with alkali, neutralise with hydrochloric acid and repeat the Benedict's test

C boil with hydrochloric acid, neutralise with alkali and repeat the Benedict's test

D repeat the Benedict's test but add more Benedict's reagent

---

219. 9700_s20_qp_13 Q: 6

The colour of a positive Benedict's test is due to the formation of copper oxide. The mass of copper oxide is proportional to the mass of reducing sugar present.

Samples of fruit juice were tested for the presence of reducing sugars and non-reducing sugars using the Benedict's test.

The table shows the mass of copper oxide after boiling with Benedict's solution and after acid hydrolysis and boiling with Benedict's solution.

Which sample contained the most **non-reducing** sugar?

	mass of copper oxide / mg	
	after boiling with Benedict's solution	after acid hydrolysis and boiling with Benedict's solution
A	20	20
B	30	45
C	50	55
D	65	75

220. 9700_w20_qp_11 Q: 7

A student carried out the Benedict's test on two different types of milk, X and Y.

A sample of each type of milk was heated to 100 °C in a water-bath with Benedict's solution and the time taken for the first appearance of a colour change was recorded.

The results are shown in the table.

type of milk	time for first appearance of a colour change with Benedict's solution / s
X	13
Y	26

Which row shows the biological molecule the student detected in each sample of milk and the sample of milk with the highest concentration of this biological molecule?

	biological molecule present in each sample of milk	sample of milk with the highest concentration of this biological molecule
A	glucose	X
B	glucose	Y
C	reducing sugar	X
D	reducing sugar	Y

---

221. 9700_w20_qp_12 Q: 7

Diastase is an enzyme that breaks down starch into maltose. Maltose is a reducing sugar.

A sample of starch is treated with boiled diastase and left for 15 minutes.

Samples of the mixture are then tested with iodine solution and with Benedict's reagent.

What are the results?

	iodine solution	Benedict's reagent
A	blue-black	blue
B	blue-black	red
C	brown	blue
D	brown	red

---

222. 9700_w20_qp_13 Q: 7

A student carried out tests for biological molecules on the **same** sample of milk.

The tests and their results were as follows.

- Heating to 80 °C with Benedict's solution gave a red colour.
- Boiling with acid, followed by neutralisation, then heating to 80 °C with Benedict's solution also gave a red colour.
- Adding Biuret solution gave a purple colour.
- Adding iodine solution gave a yellow colour.

Which biological molecules **must** be present in the milk?

1 non-reducing sugars

2 protein

3 reducing sugars

4 starch

A 1, 2 and 3 **B** 1 and 2 only **C** 2 and 3 only **D** 3 and 4

---

223. 9700_m19_qp_12 Q: 7

Four solutions were tested with Benedict's solution. The table shows the colour of the solutions after testing.

solution	colour
1	green
2	blue
3	brick red
4	yellow

Which row shows solutions that could have given these results?

	solution 1	solution 2	solution 3	solution 4
A	0.05% reducing sugar	0.5% non-reducing sugar	1.0% reducing sugar	0.1% reducing sugar
B	0.5% reducing sugar	0.0% reducing sugar	1.0% reducing sugar	0.1% reducing sugar
C	1.0% reducing sugar	1.0% non-reducing sugar	1.5% reducing sugar	0.5% reducing sugar
D	0.05% non-reducing sugar	0.5% reducing sugar	1.0% non-reducing sugar	0.1% non-reducing sugar

---

224. 9700_s19_qp_11 Q: 7

A solution of amylase was added to a suspension of starch. After 30 seconds, three samples of the mixture were tested with iodine solution, Benedict's solution or with biuret reagent.

Which are the expected results?

	colour with test reagent		
	iodine solution	Benedict's solution	biuret reagent
A	black	green	purple
B	black	red	blue
C	brown	blue	purple
D	brown	yellow	blue

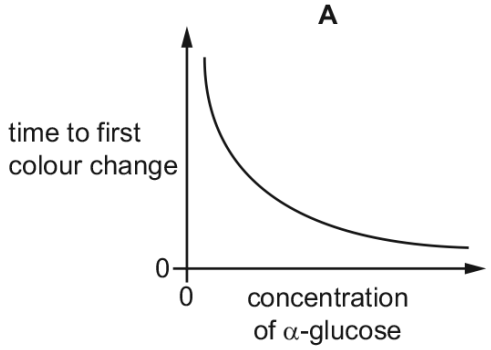
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225. 9700_s19_qp_11 Q: 8

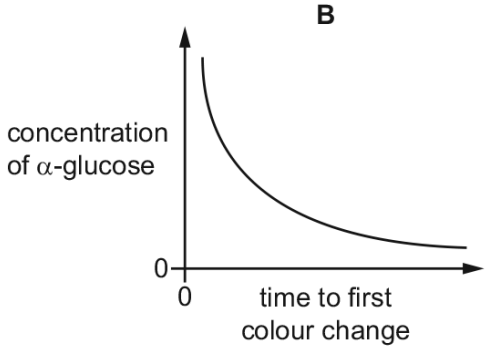
A student carried out a Benedict's test on several different known concentrations of α-glucose.

Which graph represents the results correctly?

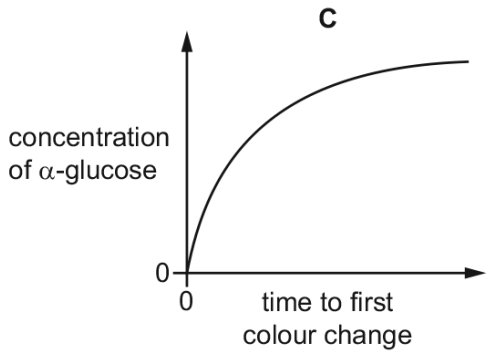
A



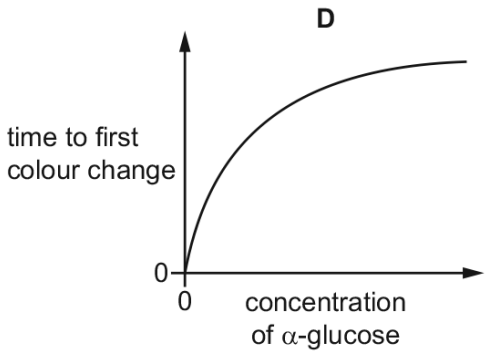
B



C



D



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226. 9700_s19_qp_12 Q: 5

After boiling a sample of milk with Benedict's solution, a yellow colour is observed.

Which conclusion about the sample of milk is correct?

A Reducing sugars are not present.

B Reducing sugars are present.

C There is a high concentration of fructose.

D There is a low concentration of sucrose.

---

227. 9700_s19_qp_13 Q: 7

A solution of amylase was added to a suspension of starch. The mixture was stirred and kept at 40 °C for 45 minutes.

Samples were then tested with various reagents.

What is the expected set of results?

	test and resulting colour		
	iodine test	Benedict's test	biuret test
A	black	blue	blue
B	black	orange	purple
C	brown	blue	blue
D	brown	orange	purple

---

228. 9700_w19_qp_11 Q: 7

Which colour indicates the lowest concentration of reducing sugar present in a solution after testing with Benedict's solution?

A brown

B green

C red

D yellow

---

229. 9700_w19_qp_12 Q: 8

A student was asked to estimate the concentration of reducing sugar in an unknown solution using the Benedict's test. Five reducing sugar solutions with different concentrations were provided in order to produce a calibration curve.

The student added 2 cm^3 of Benedict's solution to each of the reducing sugar solutions, heated them in a water-bath and recorded the time taken for the first appearance of a colour change.

Which variables should the student standardise, when carrying out the Benedict's test on each reducing sugar solution, to ensure the results are comparable?

1 volume of reducing sugar used

2 the temperature of the water-bath

3 the time the solutions are heated

A 1, 2 and 3 **B** 1 and 2 only **C** 1 and 3 only **D** 3 only

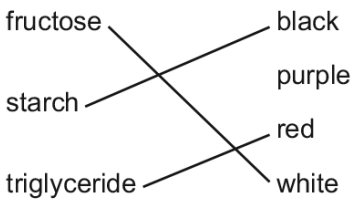
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230. 9700_w19_qp_13 Q: 6

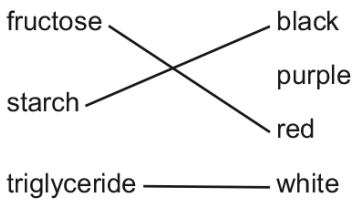
Tests for biological molecules were carried out on food samples.

Which correctly matches the biological molecules in the food samples with the colour for a positive result?

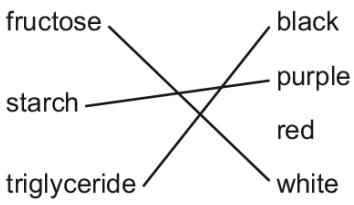
A



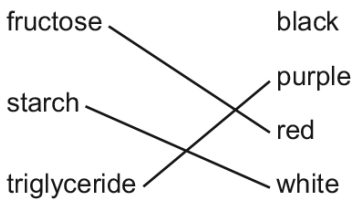
B



C



D



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231. 9700_s18_qp_12 Q: 6

A student was asked to estimate the concentration of glucose in a solution using the Benedict's test. The student was provided with a 1.0 mol dm^{-3} glucose solution and was told to make a 0.6 mol dm^{-3} solution by proportional dilution.

Which row shows the correct volumes of both 1.0 mol dm^{-3} glucose solution and distilled water needed to make the 0.6 mol dm^{-3} solution?

	volume of 1.0 mol dm^{-3} glucose solution / cm^3	volume of distilled water / cm^3
A	12	8
B	10	10
C	8	12
D	6	14

---

232. 9700_w18_qp_13 Q: 7

A student carried out tests on the same volume of four different solutions to investigate the presence of protein, starch and reducing sugar in each.

The results are shown in the table.

solution	Benedict's solution	biuret reagent	iodine solution
1	blue	purple	yellow
2	orange	pale purple	blue-black
3	orange	purple	yellow
4	red	pale blue	yellow

Which conclusion can be drawn from these results?

A Solution 1 has a lower protein and lower reducing sugar content than solution 2.

B Solution 2 has less starch compared to solutions 1, 3 and 4.

C Solution 3 has the most protein and the least starch.

D Solution 4 has a high reducing sugar content and no starch.

---

233. 9700_m17_qp_12 Q: 7

A sample of milk is tested with Benedict's solution. After boiling, a yellow colour is observed.

Which conclusion is correct?

A A high concentration of glucose is present.

B A low concentration of sucrose is present.

C No reducing sugars are present.

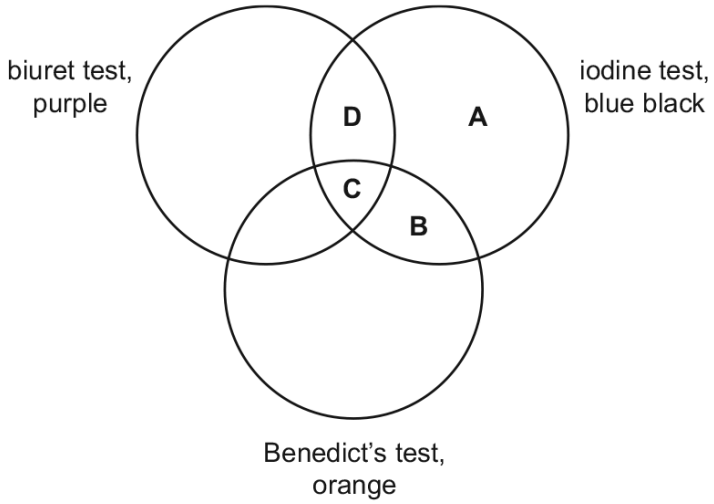
D Reducing sugars are present.

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234. 9700_s17_qp_12 Q: 9

The diagram shows the results of tests on four solutions containing biological molecules.

Which shows the solution that contains only starch and protein?



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235. 9700_s17_qp_13 Q: 5

Steps 1–4 are used to test for a non-reducing sugar.

1 Put 5 cm^3 of solution into a test-tube.

2 Add a few drops of acid.

3 Neutralise with alkali.

4 Add 6 cm^3 Benedict's solution.

When is the solution boiled?

A between steps 1 and 2

B between steps 2 and 3 and after step 4

C between steps 2 and 3 only

D after step 4 only

---

236. 9700_w17_qp_11 Q: 6

Which carbohydrate gives a brick red colour when boiled with Benedict's solution?

A cellulose

B fructose

C glycogen

D sucrose

---

237. 9700_w17_qp_12 Q: 7

A student carried out four tests for biological molecules on a sample of milk.

The tests and their results were as follows.

- Heating to 80 °C with Benedict's solution gave a brick red colour.
- Adding Biuret solution gave a purple colour.
- Adding iodine solution gave an orange colour.
- Boiling with acid, followed by neutralisation, then heating to 80 °C with Benedict's solution gave a brick red colour.

Which biological molecules **must** be present in the milk?

1 non-reducing sugars

2 protein

3 reducing sugars

4 starch

A 1, 2 and 3 **B** 1 and 2 only **C** 2 and 3 only **D** 3 and 4

---

238. 9700_w17_qp_13 Q: 6

A student carried out four tests for biological molecules on a sample of milk.

The tests and their results were as follows.

- Heating to 80 °C with Benedict's solution gave a green colour.
- Adding Biuret solution gave a purple colour.
- Adding iodine solution gave an orange colour.
- Boiling with acid, followed by neutralisation, then heating to 80 °C with Benedict's solution gave a brick red colour.

Which conclusion about these results is correct?

A only protein and reducing sugar present

B only protein and non-reducing sugar present

C only protein, reducing sugar and non-reducing sugar present

D only starch, protein and sugar present

---

239. 9700_s16_qp_11 Q: 6

Two solutions, 1 and 2, one containing starch and sucrose, and the other containing glucose and protein, were tested with a variety of reagents to confirm their identity.

The table shows the conclusions from the results recorded for the various tests.

Which row identifies the two solutions?

	add iodine solution		boil with Benedict's solution		boil with Benedict's solution after acid hydrolysis		add biuret solution	
	1	2	1	2	1	2	1	2
A	+	–	+	–	–	+	–	+
B	–	+	+	–	+	–	–	+
C	+	–	–	+	+	–	–	+
D	–	+	+	–	+	+	+	–

key

+ = biological molecule present

– = biological molecule absent

---

240. 9700_s16_qp_13 Q: 6

A sample of milk was tested with Benedict's solution and a yellow colour was observed.

Which conclusion is correct?

A No non-reducing sugars are present.

B Reducing sugars are present.

C There is a high concentration of glucose.

D There is a high concentration of sucrose.

---

241. 9700_w16_qp_11 Q: 6

In order to estimate the quantity of glucose in a solution, equal volumes of a range of known concentrations were mixed with equal excess volumes of Benedict's solution and placed in a thermostatically controlled water-bath at 90 °C for the same length of time.

The unknown solution was then treated in the same way and the colours of the known and unknown solutions compared.

What is the independent variable in this procedure?

A concentration of glucose

B final colour of solutions

C temperature of water-bath

D volumes of glucose solutions

---

242. 9700_w16_qp_13 Q: 6

A student carried out the Benedict's test on four different concentrations of glucose solution and then recorded the time taken for the first appearance of a colour change (the end-point).

The student found it difficult to identify the first appearance of a colour change and consistently timed each solution for two seconds after it had appeared. This introduced a source of error into the experiment.

Which statements about this error are correct?

1 The effect of the error will be reduced if the student performs three repeats at each concentration of glucose.

2 The error will prevent the student from identifying which solution has the highest concentration of glucose.

3 The error is systematic as the student consistently timed each solution for two seconds after the end-point.

A 1 and 2 **B** 1 and 3 **C** 2 and 3 **D** 3 only

---

243. 9700_s15_qp_11 Q: 7

A student carried out four tests for biological molecules on a solution. The observations are shown in the table.

test for biological molecules	observation
iodine solution	orange
biuret	purple
Benedict's	orange
emulsion	cloudy

Which molecules may be present in this solution?

A glucose, starch, protein

B lipid, protein, glucose

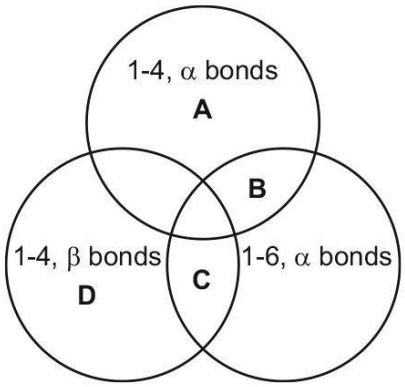
C protein, starch, sucrose

D starch, protein, lipid

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244. 9700_s15_qp_12 Q: 11

Which bonds are found in glycogen?



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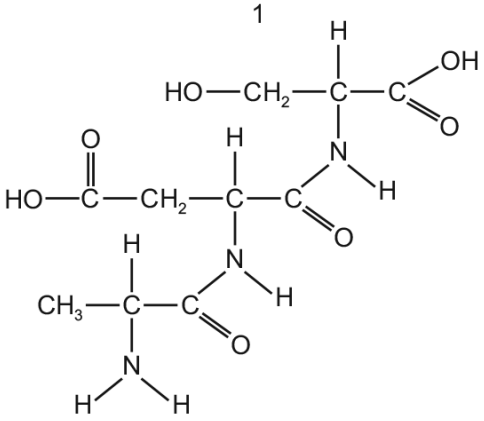
245. 9700_s15_qp_13 Q: 12

A student carried out four tests for biological molecules. The observations are shown in the table.

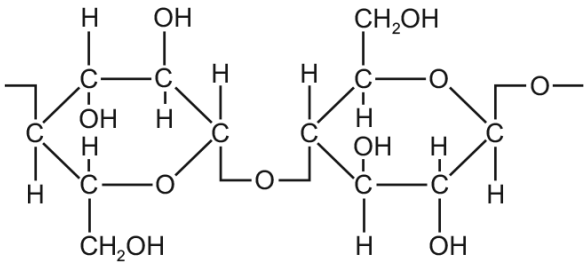
test	observations
iodine	orange
biuret	purple
Benedict's	orange
emulsion	clear

Which molecules are present in the solution?

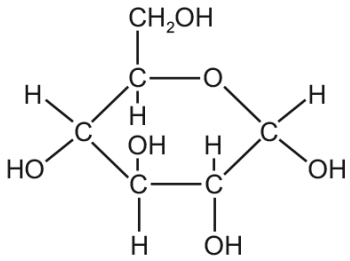
1



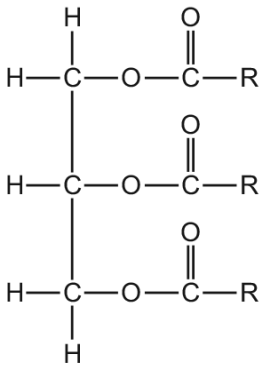
2



3



4



A 1 and 2 **B** 1 and 3 **C** 2 and 3 **D** 3 and 4

246. 9700_w15_qp_11 Q: 8

Tests for biological molecules were carried out on three solutions.

The observations were as follows.

solution 1	Benedict's test – blue to orange
solution 2	Benedict's test after acid hydrolysis – blue to red
solution 3	biuret test – blue to purple

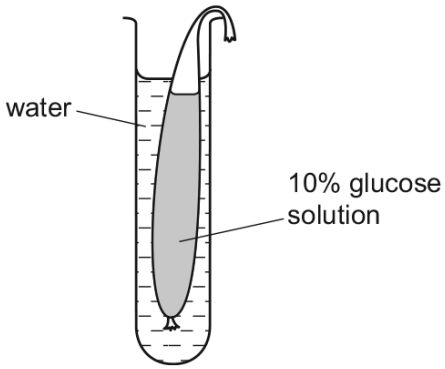
Which observations would show the solutions that contained sucrose and amylase?

A 1, 2 and 3 **B** 1 and 3 only **C** 2 and 3 only **D** 2 only

---

247. 9700_w15_qp_11 Q: 17

The diagram shows apparatus set up to investigate the effect of putting a 10% glucose solution in a selectively permeable bag (Visking tubing) and surrounding it with water.



Samples from the surrounding water were tested with Benedict's solution after 10 minutes and after 20 minutes. The change in volume of glucose solution was observed after 20 minutes.

Which row is correct?

	result of Benedict's test		volume of glucose solution in Visking tubing / cm^3
	after 10 minutes	after 20 minutes	
A	green	blue	increased
B	green	orange	increased
C	red	orange	decreased
D	yellow	green	decreased

---

248. 9700_w15_qp_12 Q: 7

The colour of a positive Benedict's test is due to the formation of copper oxide. The mass of copper oxide is proportional to the mass of reducing sugar present.

Samples of fruit juice were tested for the presence of reducing sugars and non-reducing sugars using the Benedict's test. The results show the mass of copper oxide after boiling with Benedict's solution and after acid hydrolysis and boiling with Benedict's solution.

Which sample contained the most **non-reducing** sugar?

	mass of precipitate / mg	
	after boiling with Benedict's solution	after acid hydrolysis and boiling with Benedict's solution
A	20	20
B	30	45
C	50	55
D	65	75

---

249. 9700_w15_qp_13 Q: 7

The table shows the results of tests carried out on a sample of biological molecules.

test	colour observed
Benedict's	blue
biuret	purple
iodine	blue-black

Which shows the types of molecules present in the sample?

	protein	reducing sugar	starch
A	✓	✗	✗
B	✗	✓	✗
C	✓	✗	✓
D	✗	✓	✓

key
✓ present
✗ absent

2.2 Carbohydrates and lipids

250. 9700_m20_qp_12 Q: 8

Which statement about biological molecules is correct?

A Amylopectin, amylose and cellulose are all polymers.

B Amylose, cellulose and glucose are all macromolecules.

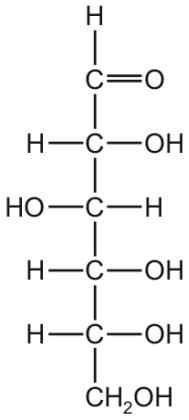
C Cellulose, glucose and starch are all monomers.

D Sucrose, starch and amylopectin are all polysaccharides.

---

251. 9700_m20_qp_12 Q: 9

Sugars with a ring structure can also have a linear structure.



Which of these sugar molecules could be represented by the linear structure in the diagram?

1 glucose

2 ribose

3 sucrose

A 1 and 2 **B** 2 and 3 **C** 1 only **D** 2 only

---

252. 9700_m20_qp_12 Q: 10

Which statements about phospholipids and triglycerides are correct?

1 They both contain ester bonds.

2 They both have three fatty acid chains per molecule.

3 They both may have saturated and unsaturated fatty acid chains.

4 They are both used only as storage molecules.

A 1, 2 and 3 **B** 1 and 3 only **C** 2, 3 and 4 **D** 2 and 4 only

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253. 9700_s20_qp_11 Q: 7

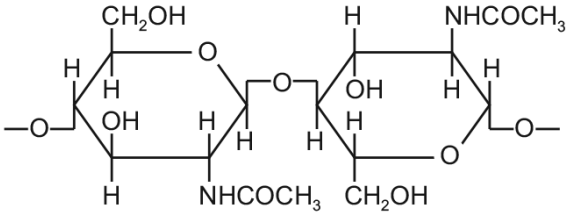
Maltose and sucrose are disaccharides. Maltose is formed from two molecules of glucose, whilst sucrose is formed from fructose and glucose.

Which row shows the molecular formulae of the two disaccharides?

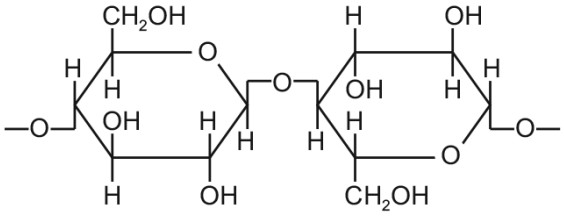
	maltose	sucrose
A	$C_{12}H_{22}O_{11}$	$C_{12}H_{22}O_{11}$
B	$C_{12}H_{22}O_{11}$	$C_{12}H_{24}O_{12}$
C	$C_{12}H_{24}O_{12}$	$C_{12}H_{22}O_{11}$
D	$C_{12}H_{24}O_{12}$	$C_{12}H_{24}O_{12}$

254. 9700_s20_qp_11 Q: 8

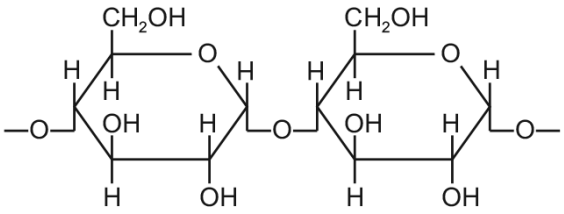
The diagrams show short sections of some common polysaccharides and modified polysaccharides.



1



2



3

The polysaccharides can be described as:

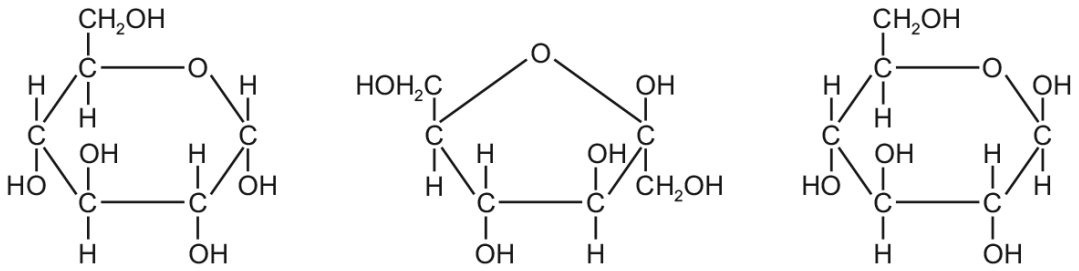
- F is composed of β-glucose monomers with 1,4 glycosidic bonds
- G is composed of α-glucose monomers with 1,4 glycosidic bonds
- H is composed of N-acetylglucosamine monomers with β-1,4 glycosidic bonds.

Which row correctly matches the numbered diagrams to the descriptions of the polysaccharides?

	polysaccharide F	polysaccharide G	polysaccharide H
A	2	1	3
B	2	3	1
C	3	1	2
D	3	2	1

255. 9700_s20_qp_12 Q: 8

The diagrams show three hexoses.



1 2 3

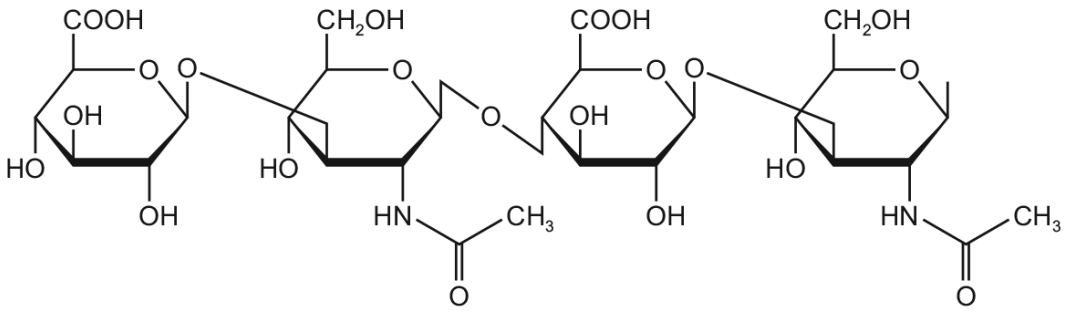
In which carbohydrates do these three hexoses occur?

	sucrose	cellulose	glycogen
A	1	2	3
B	1	3	2
C	2	3	1
D	3	2	1

---

256. 9700_s20_qp_12 Q: 9

The diagram shows part of the chemical structure of a naturally occurring polysaccharide.



What types of glycosidic bonds are present?

A α-1,3 and α-1,4

B α-1,4 and α-1,6

C β-1,3 and β-1,4

D β-1,4 and β-1,6

---

257. 9700_s20_qp_12 Q: 10

What is the maximum number of water molecules produced when a triglyceride is synthesised?

A 3 **B** 2 **C** 1 **D** 0

---

258. 9700_s20_qp_13 Q: 7

Which polysaccharides contain 1, 4 **and** 1, 6 glycosidic bonds?

1 amylopectin

2 amylose

3 cellulose

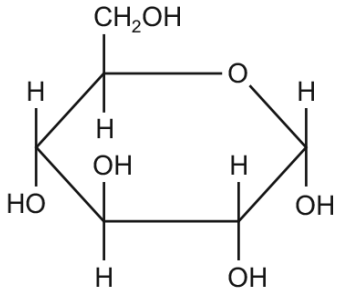
4 glycogen

A 1 and 3 **B** 1 and 4 **C** 2 and 3 **D** 4 only

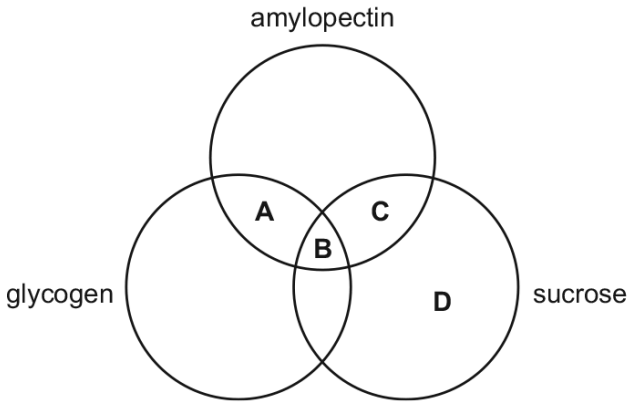
---

259. 9700_w20_qp_11 Q: 8

The diagram shows the structure of a monomer.



Which molecules contain this monomer?



---

260. 9700_w20_qp_11 Q: 9

Which molecules are formed by condensation which involves a carboxyl group?

A amylopectin, collagen, triglyceride, sucrose

B amylopectin, collagen, triglyceride

C amylopectin, β-globin, sucrose

D collagen, β-globin, triglyceride

---

261. 9700_w20_qp_11 Q: 10

Which row correctly matches the function with the structural features of cellulose, collagen, glycogen or triglyceride?

	molecule	function	structure		
			fibrous	molecules held together by hydrogen bonds	branched chains
A	cellulose triglyceride	support energy source	✓ ✗	✓ ✗	✗ ✗
B	collagen cellulose	strengthening support	✓ ✓	✓ ✗	✗ ✓
C	collagen glycogen	strengthening storage	✓ ✗	✓ ✗	✓ ✓
D	glycogen triglyceride	storage energy source	✗ ✗	✓ ✓	✓ ✗

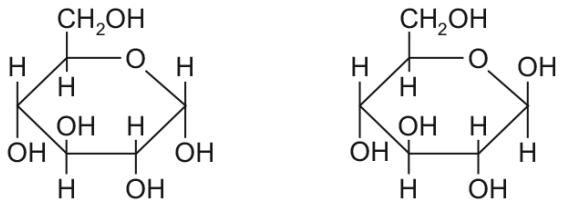
key ✓ = correct ✗ = not correct

---

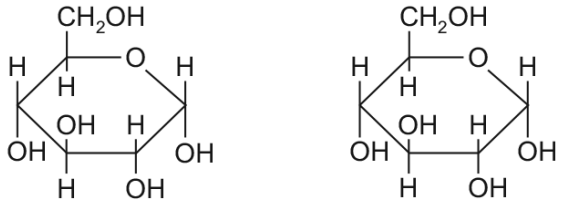
262. 9700_w20_qp_12 Q: 8

Which pair of monosaccharides forms sucrose?

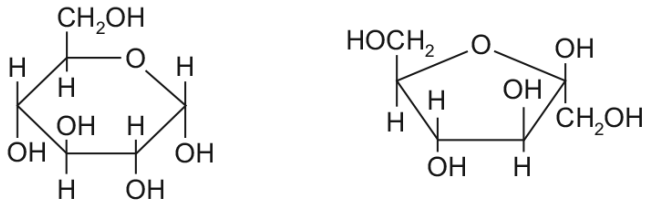
A



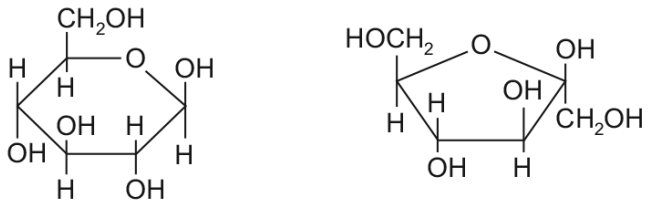
B



C



D



263. 9700_w20_qp_13 Q: 8

Which row is correct for carbohydrates?

	monomer	polymer	macromolecule
A	fructose	amylose	cellulose
B	glucose	deoxyribose	amylopectin
C	monosaccharide	glycogen	deoxyribose
D	sucrose	starch	glycogen

264. 9700_w20_qp_13 Q: 9

Which molecules contain 1,6 glycosidic bonds?

1 amylopectin

2 glycogen

3 starch

A 1, 2 and 3 **B** 1 and 2 only **C** 1 and 3 only **D** 2 and 3 only

---

265. 9700_w20_qp_13 Q: 10

Which row correctly shows the ratio of carbon atoms to hydrogen atoms for glucose, a saturated fatty acid and sucrose?

	ratio of carbon atoms to hydrogen atoms		
	glucose	saturated fatty acid	sucrose
A	1:2	1:2	1:1.8
B	1:2	4:1	1:2
C	2:1	1:4	2:1
D	2:1	2:1	1.8:1

---

266. 9700_w20_qp_13 Q: 11

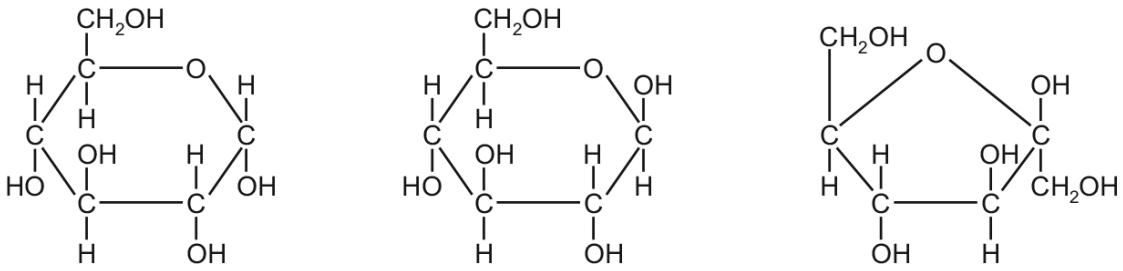
Which row shows a correct comparison between a phospholipid molecule and a triglyceride molecule?

	phospholipid molecule	triglyceride molecule
A	contains a hydrophobic phosphate group	is a hydrophobic molecule
B	contains one glycerol molecule	contains three glycerol molecules
C	fewer ester bonds	more ester bonds
D	more fatty acids	fewer fatty acids

---

267. 9700_m19_qp_12 Q: 8

The diagram shows a molecule of three hexose sugars.



1 2 3

Which row correctly shows examples of carbohydrates in which these three hexose sugars occur?

	sucrose	cellulose	amylopectin
A	1	2	3
B	1	3	2
C	2	3	1
D	3	2	1

---

268. 9700_m19_qp_12 Q: 9

Which feature of glycogen distinguishes glycogen from starch?

A All glycogen molecules are highly branched.

B All glycogen molecules are polysaccharides.

C All glycogen molecules contain α-glucose.

D All glycogen molecules contain 1,4-glycosidic bonds.

---

269. 9700_m19_qp_12 Q: 10

A student wrote four statements about what happens during hydrolysis of a carbohydrate.

1 Disaccharides are formed from monosaccharides.

2 Glycosidic bonds are broken.

3 Molecules of water are released.

4 Monosaccharides can be formed.

Which statements are correct?

A 1 and 2 **B** 1 and 3 **C** 2 and 4 **D** 3 and 4

---

270. 9700_m19_qp_12 Q: 11

The table compares three molecules, X, Y and Z, which contain the elements carbon, hydrogen and oxygen only.

The percentage of carbon, hydrogen and oxygen atoms in each molecule is shown.

molecule	% carbon	% hydrogen	% oxygen
X	25.0	50.0	25.0
Y	28.5	47.7	23.8
Z	34.6	61.6	3.8

Which row correctly identifies molecules X, Y and Z?

	molecule		
	X	Y	Z
A	monosaccharide	disaccharide	polysaccharide
B	monosaccharide	polysaccharide	triglyceride
C	polysaccharide	triglyceride	monosaccharide
D	triglyceride	monosaccharide	polysaccharide

---

271. 9700_m19_qp_12 Q: 12

Which statements about the differences between phospholipids and triglycerides are correct?

1 Phospholipids have hydrophobic regions but triglycerides do not.

2 The fatty acids in a phospholipid are always saturated but in a triglyceride they may be saturated or unsaturated.

3 Phospholipids are polar molecules but triglycerides are non-polar.

A 1 and 2 **B** 1 only **C** 2 and 3 **D** 3 only

---

272. 9700_m19_qp_12 Q: 13

An investigation was carried out into the effect of different treatments on the permeability of the cell surface membranes and tonoplasts of beetroot cells. Beetroot cell vacuoles contain a red pigment. This pigment is unable to pass out of the cells because it cannot diffuse through the tonoplasts or cell surface membranes.

1 cm^3 cubes were cut from beetroot tissue and washed in running water for 20 minutes to remove any pigment released from damaged cells.

The cubes were then placed in test-tubes with different contents and observed for five minutes.

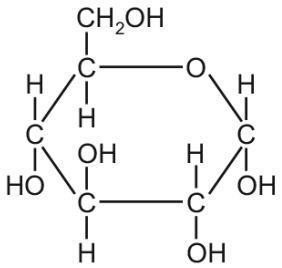
Which row shows a correct explanation for the observation recorded for one of the treatments?

	treatment	observation	explanation
A	dilute hydrochloric acid	contents of test-tube stay clear	membrane proteins have been denatured
B	ethanol	contents of test-tube turn red	lipids, including membrane phospholipids, have dissolved
C	water at 20 °C	contents of test-tube stay clear	membrane proteins have been denatured
D	water at 80 °C	contents of test-tube turn red	lipids, including membrane phospholipids, have dissolved

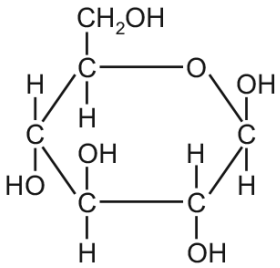
---

273. 9700_s19_qp_11 Q: 9

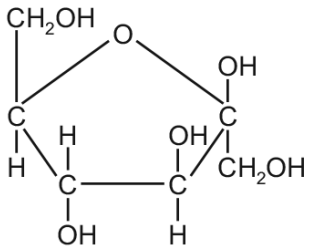
The diagram shows three hexose sugars.



1



2



3

Which row correctly shows examples of carbohydrates in which these three hexose sugars occur?

	sucrose	cellulose	starch
A	1	2	3
B	1	3	2
C	2	3	1
D	3	2	1

---

274. 9700_s19_qp_11 Q: 10

What can occur during condensation of carbohydrates?

A a disaccharide is produced from monosaccharides

B glycosidic bonds are broken

C molecules of water are used up

D monosaccharides are produced

---

275. 9700_s19_qp_11 Q: 11

What is true about triglycerides?

	hydrophobic	insoluble in alcohol
A	✓	✓
B	✓	✗
C	✗	✓
D	✗	✗

key

✓ = correct

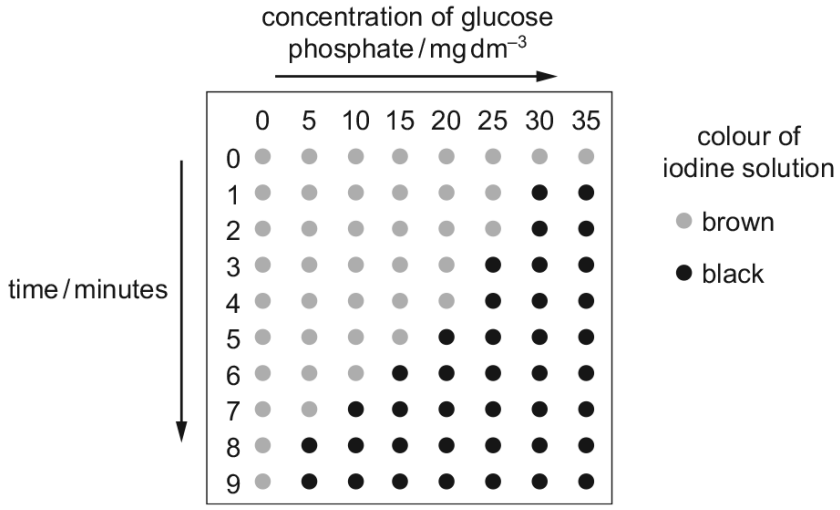
✗ = not correct

---

276. 9700_s19_qp_11 Q: 13

In an investigation, the same concentration of the enzyme phosphorylase was added to different concentrations of glucose phosphate and incubated at 30 °C. At 1 minute intervals, one drop of the reaction mixture was removed and added to a drop of iodine solution on a white tile.

The diagram shows the results of this investigation.



What explains the trend in the results of this investigation?

A Phosphorylase catalyses a reaction converting glucose phosphate to starch.

B The maximum rate of reaction is reached at 20 mg dm^{-3} of glucose phosphate.

C Substrate concentration is limiting at concentrations of glucose phosphate 25 mg dm^{-3} or less.

D Enzyme concentration is limiting at concentrations of glucose phosphate 25 mg dm^{-3} or less.

---

277. 9700_s19_qp_12 Q: 6

Which of the statements about polysaccharides can be used to describe amylose and cellulose?

1 contains 1,4 glycosidic bonds

2 contains 1,6 glycosidic bonds

3 polymer of glucose

A 1 and 2

B 1 and 3

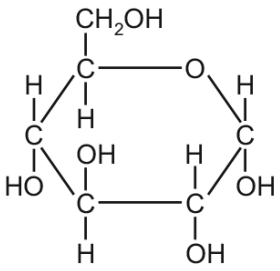
C 1 only

D 2 and 3

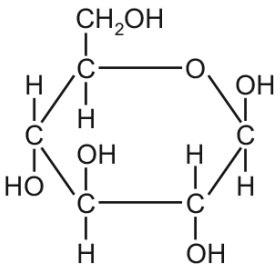
---

278. 9700_s19_qp_13 Q: 8

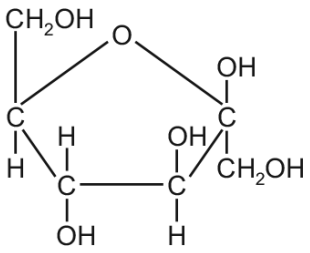
The diagram shows three hexose sugars.



1



2



3

Which row correctly shows examples of carbohydrates in which these three hexose sugars occur?

	sucrose	cellulose	amylose
A	1	2	3
B	1	3	2
C	2	3	1
D	3	2	1

---

279. 9700_s19_qp_13 Q: 9

What can occur as a result of a condensation reaction?

1 A disaccharide is formed.

2 A glycosidic bond is broken.

3 A molecule of water is produced.

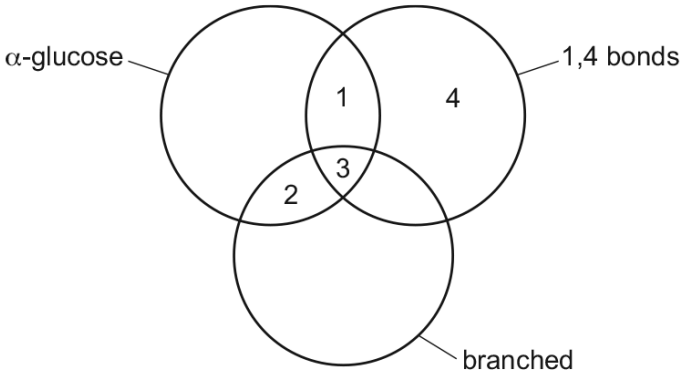
4 Two monosaccharides join together.

A 1, 2 and 3 **B** 1, 2 and 4 **C** 1, 3 and 4 **D** 2, 3 and 4

---

280. 9700_s19_qp_13 Q: 10

The diagram shows some relationships between features of carbohydrates.



Which row correctly matches the carbohydrate with some of its features?

	1	2	3	4
A	amylopectin	sucrose	glycogen	cellulose
B	amylose	glycogen	amylopectin	cellulose
C	cellulose	amylopectin	glycogen	sucrose
D	glycogen	cellulose	amylose	amylopectin

---

281. 9700_s19_qp_13 Q: 11

Which row describes a triglyceride?

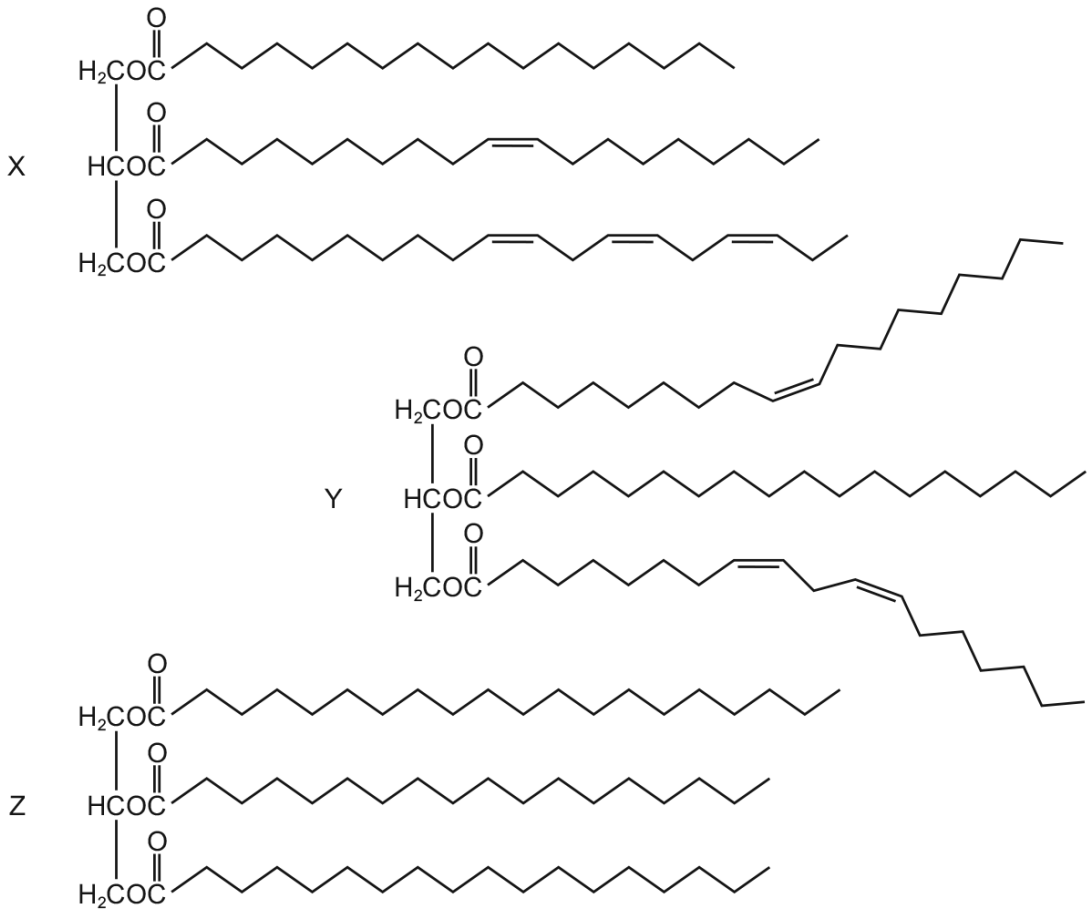
	hydrophilic	insoluble in alcohol
A	✓	✓
B	✓	✗
C	✗	✓
D	✗	✗

key
✓ = correct
✗ = not correct

---

282. 9700_s19_qp_13 Q: 12

The diagram shows three triglycerides, X, Y and Z.

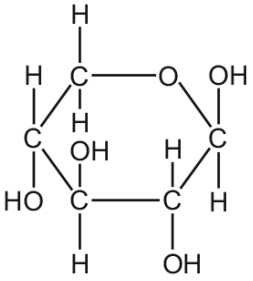


What is correct for these triglycerides?

	contains saturated fatty acids	contains unsaturated fatty acids	contains more than two different fatty acids
A	X, Y and Z	X and Y	X and Y
B	X, Y and Z	Z	X and Y
C	X and Y	X, Y and Z	X, Y and Z
D	Z	X and Y	X, Y and Z

283. 9700_w19_qp_11 Q: 6

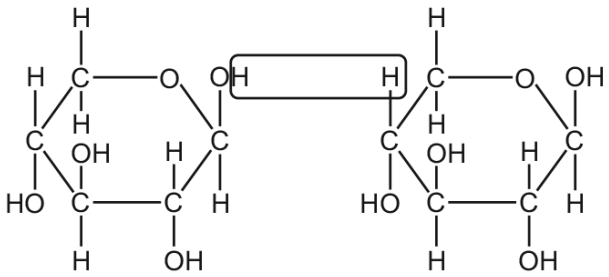
The diagram shows the monosaccharide xylose.



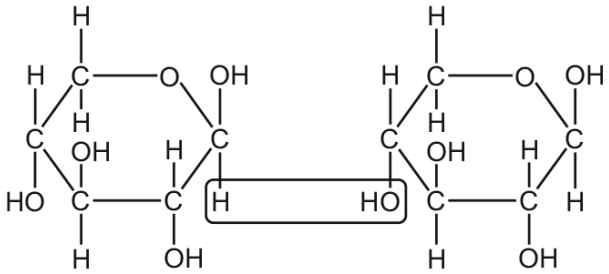
Many xylose monomers can be joined by glycosidic bonds to form a polysaccharide which is found in plant cell walls.

Which diagram shows the formation of a glycosidic bond between two xylose monomers?

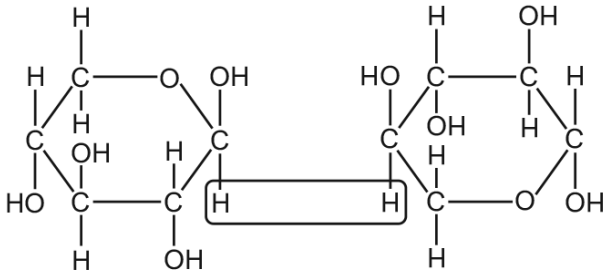
A



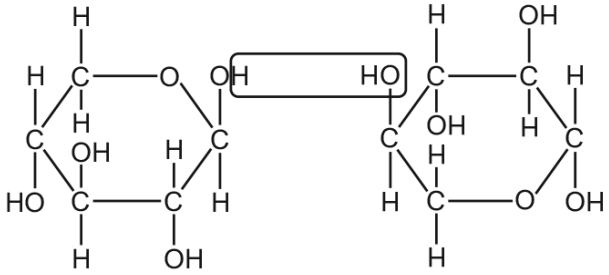
B



C



D



284. 9700_w19_qp_11 Q: 8

Which molecules are monomers?

1 ribose
2 glucose
3 deoxyribose
4 sucrose

A 1, 2 and 3 **B** 1, 2 and 4 **C** 1, 3 and 4 **D** 2, 3 and 4

---

285. 9700_w19_qp_11 Q: 9

Which molecules have properties that are dependent on hydrogen bonds?

1 cellulose
2 glycogen
3 haemoglobin
4 water

A 1, 2 and 3 **B** 1, 2 and 4 **C** 1, 3 and 4 **D** 2, 3 and 4

---

286. 9700_w19_qp_11 Q: 10

Some features of triglycerides are listed.

1 can be liquid or solid at room temperature
2 contains a high proportion of carbon–hydrogen bonds
3 insoluble in water
4 less dense than water

Which of these features make triglycerides suitable energy stores?

A 1 and 2 **B** 1 and 4 **C** 2, 3 and 4 **D** 2 and 3 only

---

287. 9700_w19_qp_12 Q: 7

A student carried out four tests for biological molecules on a solution. The results are shown in the table.

test for biological molecules	observation
iodine	orange-brown
biuret	purple
Benedict's	orange
emulsion	clear

Which three molecules may be present in this solution?

A glucose, starch, globin

B globin, glucose, collagen

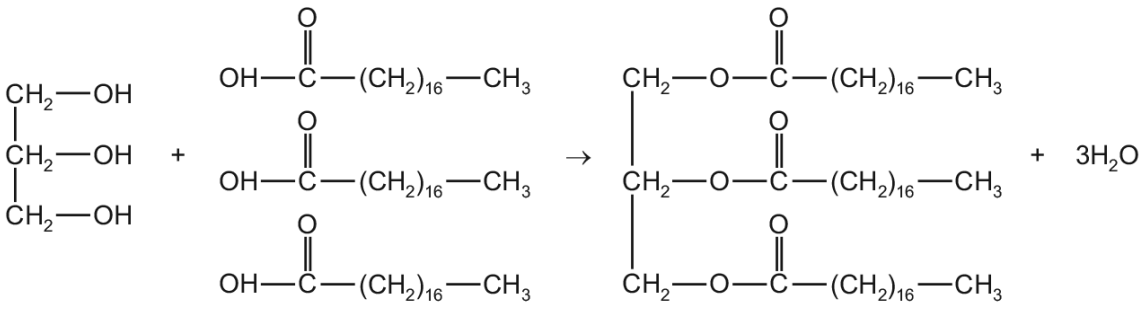
C starch, sucrose, collagen

D sucrose, globin, collagen

---

288. 9700_w19_qp_12 Q: 10

The diagram shows the formation of a biological macromolecule.



Which type of bonds are formed in the macromolecule product?

A ester bonds

B glycosidic bonds

C hydrogen bonds

D peptide bonds

---

289. 9700_w19_qp_13 Q: 7

What occurs during the formation of a glycosidic bond between two α-glucose molecules?

A a 1, 4 bond is always formed

B a hydrogen bond is always formed

C a molecule of water is always formed

D a hydroxyl (OH) group is always formed

---

290. 9700_w19_qp_13 Q: 8

What is the maximum number of condensation reactions that occur when a triglyceride is synthesized?

A 1 **B** 2 **C** 3 **D** 4

---

291. 9700_m18_qp_12 Q: 7

Which concentrations could be produced by a serial dilution of an 8.00% glucose solution?

A 4.00%, 2.00%, 1.00%, 0.50% and 0.25%

B 4.00%, 3.00%, 2.00%, 1.00% and 0.00%

C 6.00%, 4.00%, 2.00%, 1.00% and 0.50%

D 8.00%, 6.00%, 4.00%, 2.00% and 0.00%

---

292. 9700_m18_qp_12 Q: 8

A student wrote these statements about polysaccharides.

1 Amylose is formed from condensation reactions between β-glucose monomers.

2 Branches in amylopectin molecules form between carbon atoms 1 and 4 on α-glucose molecules.

3 In unbranched β-glucose chains, each monomer is rotated 180° relative to its adjacent monomer.

Which of these statements are correct?

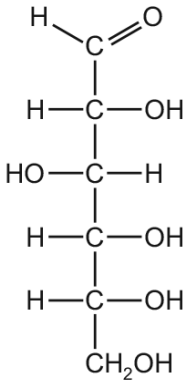
A 1 and 2 **B** 1 only **C** 2 and 3 **D** 3 only

---

293. 9700_m18_qp_12 Q: 10

Sugars with a ring structure can also have a linear structure.

Which sugar molecules could be represented by the linear structure shown in the diagram?



A α-glucose, deoxyribose and ribose

B α-glucose only

C deoxyribose and ribose only

D deoxyribose only

---

294. 9700_s18_qp_11 Q: 6

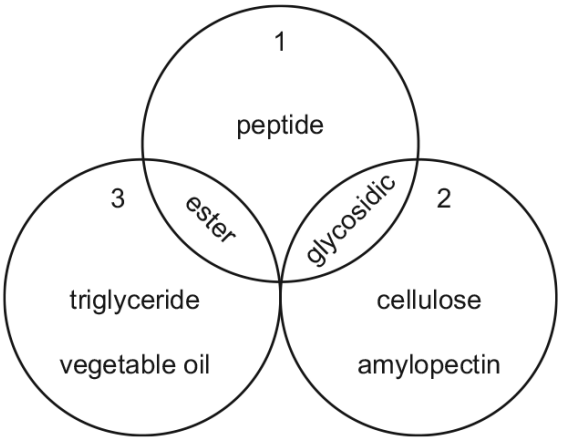
What is the general formula for amylose?

A $(C_5H_{10}O_5)_n$ **B** $(C_5H_{10}O_6)_n$ **C** $(C_6H_{10}O_5)_n$ **D** $(C_6H_{12}O_6)_n$

---

295. 9700_s18_qp_11 Q: 7

The diagram shows relationships between some important molecules and bonds.



What is represented by circles numbered 1, 2 and 3?

	1	2	3
A	bonds formed by condensation	carbohydrates	lipids
B	bonds formed by condensation	lipids	carbohydrates
C	bonds formed by hydrolysis	carbohydrates	lipids
D	bonds formed by hydrolysis	lipids	carbohydrates

---

296. 9700_s18_qp_11 Q: 8

In unsaturated lipid molecules, where are double bonds located?

A between fatty acids and glycerol

B within fatty acids and within glycerol

C within fatty acids only

D within glycerol only

---

297. 9700_s18_qp_11 Q: 9

Phospholipids and triglycerides are important biological molecules.

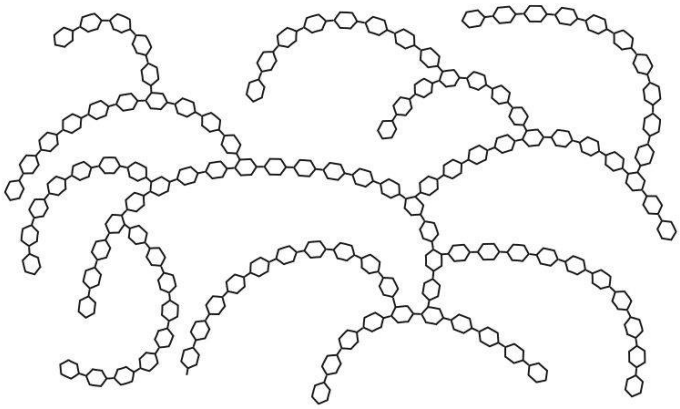
Which properties are correct for these molecules?

	non-polar	partially hydrophobic
A	phospholipid	phospholipid
B	phospholipid	triglyceride
C	triglyceride	phospholipid
D	triglyceride	triglyceride

---

298. 9700_s18_qp_12 Q: 7

The diagram shows part of a carbohydrate molecule formed by glucose.



What is the name of the molecule?

A amylose

B cellulose

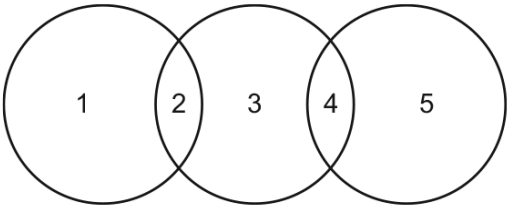
C glycogen

D starch

---

299. 9700_s18_qp_12 Q: 8

The diagram shows the relationship between some biological molecules.



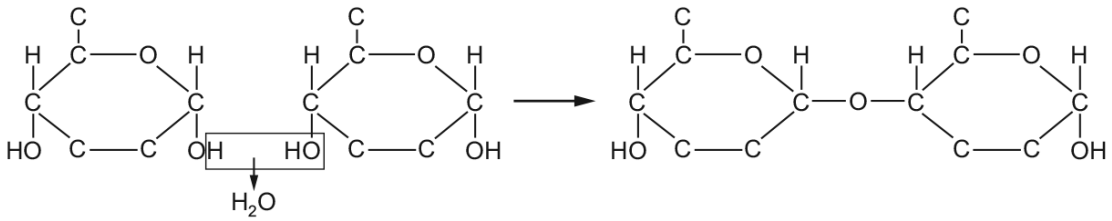
Which row is correct?

	1	2	3	4	5
A	α-glucose	carbohydrate	sucrose	monomer	fructose
B	cellulose	polymer	starch	carbohydrate	amylase
C	fructose	reducing sugar	β-glucose	monomer	amino acid
D	haemoglobin	protein	amylose	polymer	cellulose

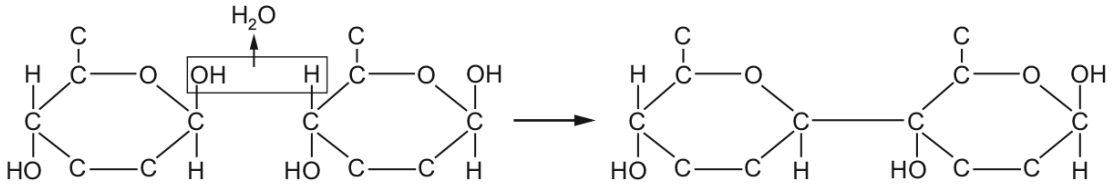
300. 9700_s18_qp_12 Q: 9

Which diagram shows the reaction that occurs to join two of the monomers that form cellulose?

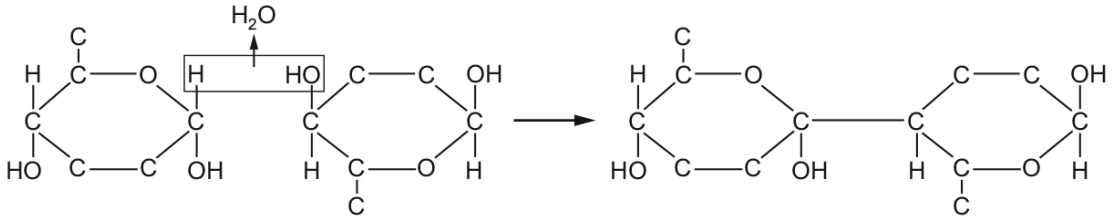
A



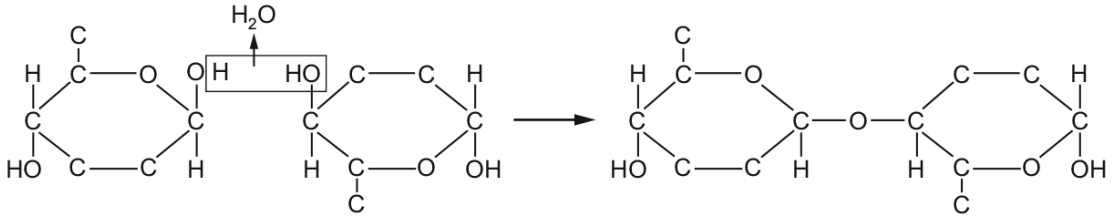
B



C



D



---

301. 9700_s18_qp_13 Q: 7

Solutions of three biological molecules are tested for sugars. The table shows the colours of the solutions after testing.

solution	heated with Benedict's solution	boiled with hydrochloric acid, neutralised, then heated with Benedict's solution
1	blue	orange
2	green	green
3	orange	red

Which solutions contained glucose before testing?

A 1, 2 and 3 **B** 1 and 2 only **C** 1 and 3 only **D** 2 and 3 only

---

302. 9700_s18_qp_13 Q: 8

A solution containing equal masses of amylose and amylopectin is completely hydrolysed.

Which molecules will be found after the hydrolysis?

A α-glucose only

B β-glucose only

C equal masses of α-glucose and β-glucose

D more α-glucose than β-glucose

---

303. 9700_s18_qp_13 Q: 9

Which molecules contain the following bonds?

	ester	hydrogen	disulfide
A	amylase	haemoglobin	catalase
B	glycerol	glycogen	collagen
C	lipids	amylopectin	amylose
D	phospholipids	cellulose	antibodies

---

304. 9700_s18_qp_13 Q: 10

Which feature of phospholipids enables a bilayer to form?

A They are insoluble in water.

B They are polar molecules.

C They have hydrophobic and hydrophilic components.

D They may contain saturated or unsaturated fatty acids.

---

305. 9700_w18_qp_11 Q: 6

Which comparison of bacteria cell walls and plant cell walls is correct?

	bacteria cell wall	plant cell wall
A	made of a polymer of α-glucose	made of cellulose
B	made of a polymer of β-glucose	made of a polymer of amino sugars
C	made of a polymer of amino sugars	made of a polymer of α-glucose
D	made of peptidoglycan	made of a polymer of β-glucose

---

306. 9700_w18_qp_11 Q: 7

A glycosidic bond is broken and two monosaccharides are formed during a positive test for a non-reducing sugar.

Which row identifies the catalyst and reactants in this process?

	catalyst	reactants
A	hydrochloric acid	fructose and glucose
B	hydrochloric acid	sucrose and water
C	sucrase enzyme	fructose and glucose
D	sucrase enzyme	sucrose and water

---

307. 9700_w18_qp_11 Q: 9

What is the general formula for cellulose?

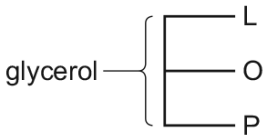
A $(C_5H_{10}O_5)_n$ **B** $(C_5H_{10}O_6)_n$ **C** $(C_6H_{10}O_5)_n$ **D** $(C_6H_{12}O_6)_n$

---

308. 9700_w18_qp_11 Q: 10

A triglyceride consists of glycerol and three different fatty acids, linoleic acid (L), oleic acid (O) and palmitic acid (P).

The diagram shows one possible arrangement of the fatty acids L, O and P in the molecule.



What is the total number of different arrangements of the fatty acids in this triglyceride?

A 3 **B** 4 **C** 5 **D** 9

---

309. 9700_w18_qp_12 Q: 7

A sample of a solution was tested for reducing sugar and the result was negative.

Another sample of the same solution was then tested for non-reducing sugar and the result was positive.

Which step in the test for non-reducing sugar breaks the glycosidic bonds?

A addition of Benedict's reagent

B addition of sodium hydroxide

C boiling with hydrochloric acid

D heating to 80 °C

---

310. 9700_w18_qp_12 Q: 8

Which row correctly identifies three polysaccharides

	α-glucose straight chain	α-glucose branching chain	β-glucose straight chain
A	amylose	amylopectin	cellulose
B	amylose	glycogen	amylopectin
C	glycogen	amylose	amylopectin
D	glycogen	amylose	cellulose

---

311. 9700_w18_qp_12 Q: 9

Which row describes a triglyceride?

	hydrophobic	insoluble in alcohol
A	✓	✓
B	✓	✗
C	✗	✓
D	✗	✗

key

✓ = correct

✗ = not correct

---

312. 9700_w18_qp_13 Q: 8

Which words correctly complete the description of amylose?

The ……1…… amylose is a ……2…… made up of ……3…… of the ……4…… glucose.

	1	2	3	4
A	macromolecule	monomer	polymers	disaccharide
B	macromolecule	monomer	polymers	monosaccharide
C	polysaccharide	polymer	monomers	disaccharide
D	polysaccharide	polymer	monomers	monosaccharide

---

313. 9700_w18_qp_13 Q: 9

Which statements about glycosidic bonds are correct?

1 They occur by condensation reactions between the OH groups of two molecules.

2 They occur only between glucose molecules.

3 The bonds can only be formed between carbon 1 and carbon 4 or carbon 1 and carbon 6 of adjacent molecules.

4 Hydrolysis of the bonds releases energy.

A 1, 2 and 3 **B** 1 and 4 **C** 2 and 4 **D** 3 and 4

---

314. 9700_w18_qp_13 Q: 10

What is the general formula for glycogen?

A $(C_5H_{10}O_5)_n$ **B** $(C_5H_{10}O_6)_n$ **C** $(C_6H_{10}O_5)_n$ **D** $(C_6H_{12}O_6)_n$

---

315. 9700_w18_qp_13 Q: 11

Which statements are correct?

1 In a triglyceride molecule the bonds between the fatty acids and the glycerol molecule are called ester bonds.

2 Triglycerides are formed by a condensation reaction between the hydroxyl group of a fatty acid molecule and one of the carboxyl groups of the glycerol molecule.

3 Triglycerides are insoluble in water because the fatty acid carbon chain is non-polar.

A 1, 2 and 3 **B** 1 and 2 only **C** 1 and 3 only **D** 2 and 3 only

---

316. 9700_m17_qp_12 Q: 8

The table shows some information about carbohydrate polymers.

Which row describes amylose?

	α-1,4 glycosidic bonds	α-1,6 glycosidic bonds	shape of molecule
A	✓	✓	branched
B	✓	✗	helical
C	✗	✓	branched
D	✗	✗	helical

key
✓ = present
✗ = absent

---

317. 9700_m17_qp_12 Q: 9

Which row about α-glucose and β-glucose molecules is correct?

	carbon atom on which the OH position is different	cellulose contains both molecules
A	1	no
B	1	yes
C	4	no
D	4	yes

---

318. 9700_s17_qp_11 Q: 7

What is the general formula for amylopectin?

A $(C_5H_{10}O_5)_n$ **B** $(C_5H_{10}O_6)_n$ **C** $(C_6H_{12}O_6)_n$ **D** $(C_6H_{10}O_5)_n$

---

319. 9700_s17_qp_11 Q: 8

Which statement describes how the molecular structure of starch is suited to its function?

A Amylose has a branched structure and amylopectin is coiled to give a compact molecule for transport.

B In the breakdown of amylose and amylopectin, many condensation reactions release stored energy.

C In the formation of amylose and amylopectin, many hydrolysis reactions allow the release of stored energy.

D The amylose-amylopectin complex is insoluble and does not affect the water potential of the cell.

---

320. 9700_s17_qp_11 Q: 9

Cows and whales are mammals that produce milk to feed their babies. Newborn whales grow faster than newborn cows. The milk of both cows and whales contains saturated fatty acids with different chain lengths.

The table shows the percentage of saturated fatty acids of different lengths in cow and whale milk.

chain length of saturated fatty acid / number of carbon atoms	percentage of saturated fatty acids in milk	
	cow	whale
4–12	22.2	0
14	10.6	13.8
16	25.5	27.9
18	40.1	29.4
> 18	1.6	28.9

Which statement about the ratio of short fatty acids (4–16 carbons) to long fatty acids (18 or more carbons) in the milk of cows and whales is correct?

A The ratio in cow milk is higher because young cows need more energy than young whales.

B The ratio in cow milk is lower because young cows need less energy than young whales.

C The ratio in whale milk is higher because young whales need less energy than young cows.

D The ratio in whale milk is lower because young whales need more energy than young cows.

---

321. 9700_s17_qp_11 Q: 10

The structure of phospholipids and triglycerides include the following.

1 glycerol linked to fatty acids

2 hydrophobic fatty acid chains

3 saturated fatty acid chains

Which structures enable the formation of a lipid bilayer in cell surface membranes?

A 1 and 2 **B** 1 and 3 **C** 2 and 3 **D** 2 only

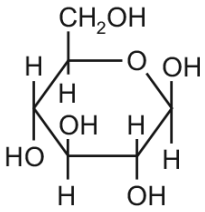
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322. 9700_s17_qp_12 Q: 7

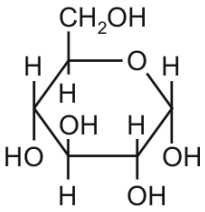
The diagrams show four monosaccharides with the formula $C_6H_{12}O_6$.

Which diagram shows α-glucose?

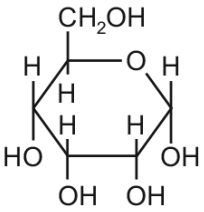
A



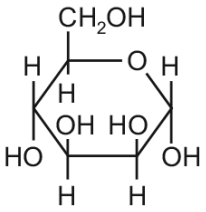
B



C



D



---

323. 9700_s17_qp_12 Q: 8

Complete digestion of polysaccharides requires all the glycosidic bonds between the monomers to be broken.

Amylase only breaks α-1,4 glycosidic bonds.

Which row shows how completely amylase can digest molecules of cellulose, amylopectin or amylose?

	polysaccharide		
	cellulose	amylopectin	amylose
A	–	++	+
B	–	+	++
C	+	++	–
D	++	–	+

key

– no digestion

\+ some digestion

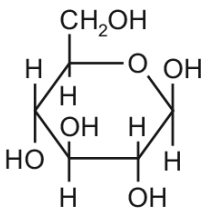
++ most digestion

---

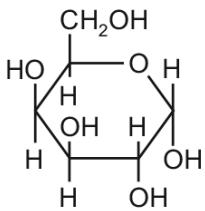
324. 9700_s17_qp_13 Q: 6

Which diagram shows the monomer of cellulose?

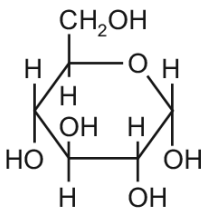
A



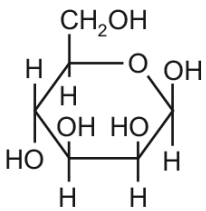
B



C



D



---

325. 9700_s17_qp_13 Q: 9

Which statements about **both** amylose and amylopectin are correct?

1 They are polymers.

2 They are formed by hydrolysis reactions.

3 They are linear molecules.

4 They contain α-1,4 glycosidic bonds.

A 1, 2, 3 and 4

B 1, 2 and 4 only

C 1 and 4 only

D 2 and 3 only

---

326. 9700_w17_qp_11 Q: 1

Which row is correct for a typical plant cell?

	cell wall	cell diameter	ribosomes
A	cellulose	1-5 μm	80S
B	cellulose	5-40 μm	70S and 80S
C	peptidoglycan	1-5 μm	70S
D	peptidoglycan	5-40 μm	70S and 80S

---

327. 9700_w17_qp_11 Q: 7

Which two polysaccharides both have 1,6 glycosidic bonds **and** are branched?

A amylopectin and amylose

B amylopectin and glycogen

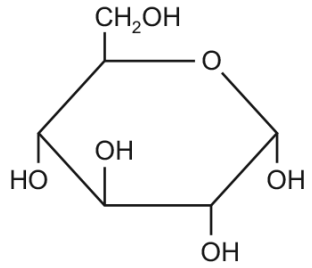
C amylose and glycogen

D glycogen and cellulose

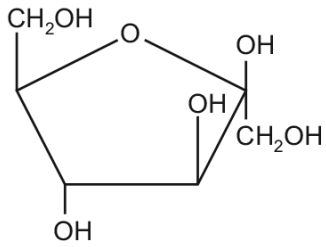
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328. 9700_w17_qp_11 Q: 8

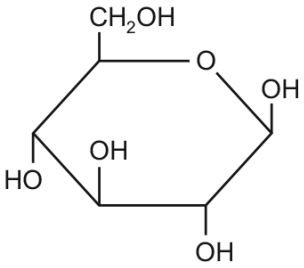
Three carbohydrate molecules are shown.



1



2



3

Which two molecules combine to form a molecule of sucrose?

A 1 and 2 **B** 1 and 3 **C** 2 and 3 **D** two of molecule 1

---

329. 9700_w17_qp_12 Q: 8

Which features adapt a cellulose molecule for its function?

1 Long chains of glucose molecules coil into a helix.

2 Many hydrogen bonds form between adjacent chains.

3 It is insoluble in water.

A 1, 2 and 3 **B** 1 and 3 only **C** 2 and 3 only **D** 2 only

---

330. 9700_w17_qp_12 Q: 9

Two disaccharides are maltose and sucrose. Maltose is formed from two molecules of glucose, whilst sucrose is formed from fructose and glucose.

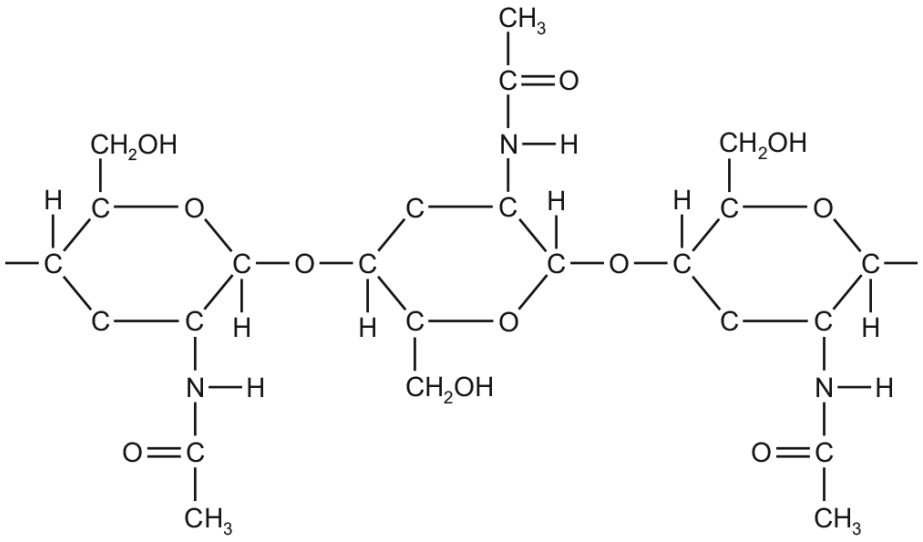
Which row shows the molecular formulae of the two disaccharides?

	maltose	sucrose
A	$C_{12}H_{22}O_{11}$	$C_{12}H_{22}O_{11}$
B	$C_{12}H_{22}O_{11}$	$C_{12}H_{24}O_{12}$
C	$C_{12}H_{24}O_{12}$	$C_{12}H_{22}O_{11}$
D	$C_{12}H_{24}O_{12}$	$C_{12}H_{24}O_{12}$

---

331. 9700_w17_qp_12 Q: 10

The diagram shows the structure of the polysaccharide chitin which is found in the cell wall of fungi.



Which statements are correct for chitin **and** for cellulose?

1 The monomers are joined by 1,4 glycosidic bonds.

2 Every second monosaccharide in the polysaccharide chain is rotated by 180°.

3 The polysaccharide contains the elements carbon, hydrogen, oxygen and nitrogen.

A 1, 2 and 3 **B** 1 and 2 only **C** 1 and 3 only **D** 2 and 3 only

---

332. 9700_w17_qp_12 Q: 13

What are the features of triglycerides?

	polar	less dense than water	lower proportion of hydrogen than in carbohydrates
A	✓	✓	✗
B	✓	✗	✓
C	✗	✓	✗
D	✗	✗	✓

key

✓ = yes

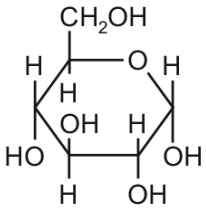
✗ = no

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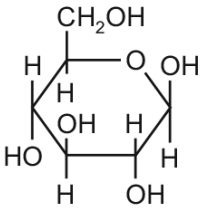
333. 9700_w17_qp_13 Q: 7

The diagrams show four monosaccharides with the formula $C_6H_{12}O_6$.

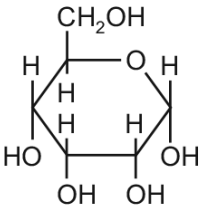
1



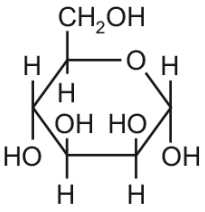
2



3



4



Which diagrams show glucose molecules?

A 1 and 2 **B** 1 and 3 **C** 2 and 3 **D** 3 and 4

---

334. 9700_w17_qp_13 Q: 8

Which bonds will be broken when a molecule of glycogen is broken down?

1 α-1, 4

2 β-1, 4

3 α-1, 6

4 β-1, 6

A 1, 2 and 3 **B** 1 and 3 only **C** 2, 3 and 4 **D** 2 and 4 only

---

335. 9700_m16_qp_12 Q: 6

What may take place during a hydrolysis reaction?

1 a molecule of water is produced

2 a glycosidic bond is broken

3 a sucrose molecule is split into fructose and glucose

A 1, 2 and 3 **B** 1 and 2 only **C** 1 and 3 only **D** 2 and 3 only

---

336. 9700_m16_qp_12 Q: 7

The table shows some information about four carbohydrate polymers.

polymer	α-1,4 glycosidic bonds	α-1,6 glycosidic bonds	shape of molecule
1	✓	✗	helical
2	✗	✓	branched
3	✓	✓	helical
4	✓	✓	branched

key
✓ = present
✗ = absent

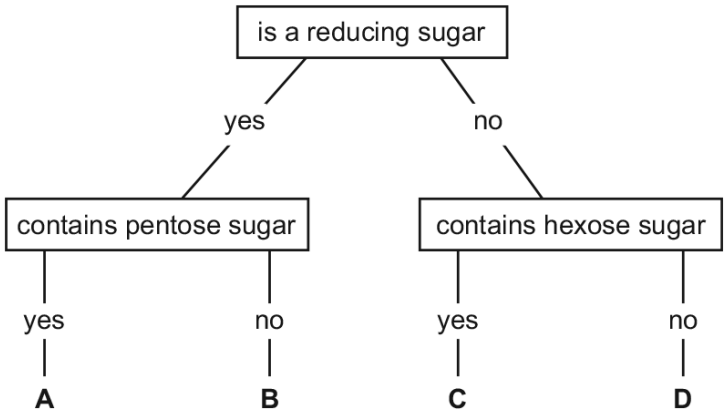
Which two polymers form starch?

A 1 and 2 **B** 1 and 4 **C** 2 and 3 **D** 3 and 4

---

337. 9700_m16_qp_12 Q: 8

Which molecule in the key is sucrose?



---

338. 9700_m16_qp_12 Q: 9

Which statements about triglycerides and phospholipids are correct?

1 Triglycerides and phospholipids both have a hydrophobic region.

2 Triglycerides are non-polar molecules and phospholipids are polar.

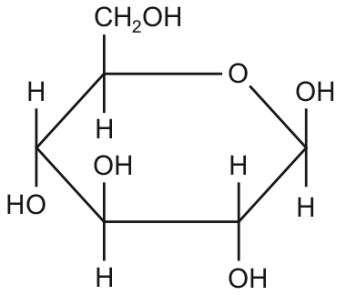
3 Fatty acids in a triglyceride may be saturated or unsaturated but in a phospholipid they are always saturated.

A 1 and 2 **B** 1 and 3 **C** 2 only **D** 3 only

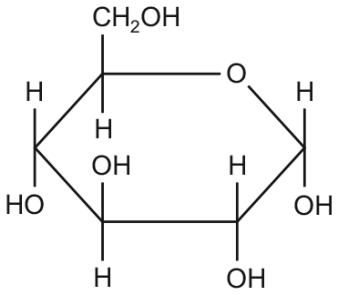
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339. 9700_s16_qp_11 Q: 7

X and Y are two monomers found in biological polymers.



X



Y

Which monomer is found in each of cellulose, glycogen, amylopectin and amylose?

	cellulose	glycogen	amylopectin	amylose
A	X	Y	X	Y
B	X	Y	Y	Y
C	Y	X	X	X
D	Y	X	Y	X

---

340. 9700_s16_qp_11 Q: 8

Chitin is a polysaccharide consisting of long straight chains of the monosaccharide acetylglucosamine, linked by 1,4 glycosidic bonds.

Acetylglucosamine is similar in structure to glucose, but contains nitrogen, allowing hydrogen bonds to form between adjacent chains of chitin when they lie parallel to each other.

Which polysaccharide is most similar in structure to chitin?

A amylopectin

B amylose

C cellulose

D glycogen

---

341. 9700_s16_qp_11 Q: 9

Which statement about triglycerides is correct?

A They are made up of three fatty acids combined with glycogen.

B They are more saturated with hydrogen compared with phospholipids.

C They form a bilayer in the cell surface membranes of cells.

D They have a lower ratio of oxygen to carbon compared with carbohydrates.

---

342. 9700_s16_qp_12 Q: 5

Which row shows the monomer and type of bond that form the polymer?

	monomer	type of bond	polymer
A	α-glucose	1,4 only	starch
B	α-glucose	1,4 and 1,6	amylopectin
C	β-glucose	1,4 only	glycogen
D	β-glucose	1,4 and 1,6	cellulose

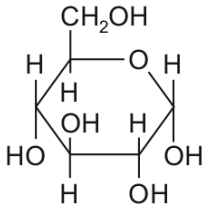
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343. 9700_s16_qp_13 Q: 7

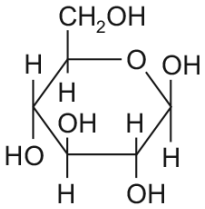
The diagrams show four monosaccharides with the formula $C_6H_{12}O_6$.

Which diagram shows β-glucose?

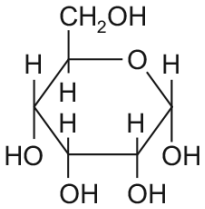
A



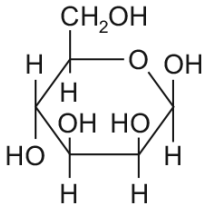
B



C



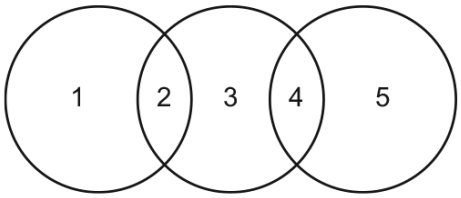
D



---

344. 9700_s16_qp_13 Q: 8

The diagram shows the relationship between different polysaccharides and the glycosidic bonds formed between the monomers.



Which row is correct?

	1	2	3	4	5
A	amylopectin	α-1,-6	glycogen	α-1,-4	amylopectin
B	amylose	α-1,-4	cellulose	β-1,-4	glycogen
C	cellulose	α-1,-4	amylose	α-1,-4	glycogen
D	glycogen	β-1,-6	amylopectin	α-1,-4	amylose

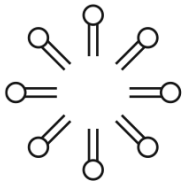
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345. 9700_s16_qp_13 Q: 9

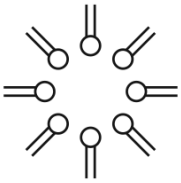
When a small quantity of phospholipid is added to a test-tube of water and then shaken vigorously, an emulsion is formed by small droplets called liposomes.

Which diagram shows the arrangement of phospholipid molecules in a cross-section of a liposome?

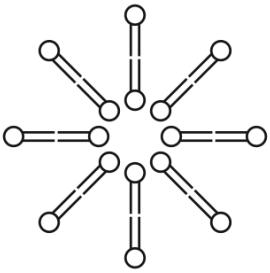
A



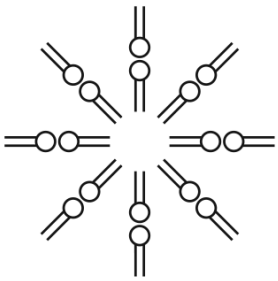
B



C



D



---

346. 9700_w16_qp_11 Q: 7

What **cannot** occur as a result of a condensation reaction?

A breaking of a glycosidic bond

B formation of a disaccharide

C joining together two amino acids

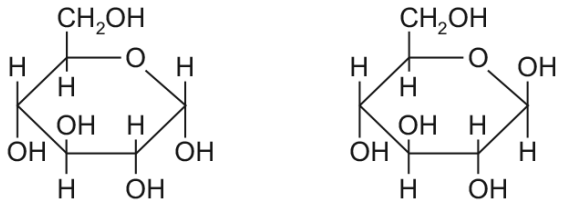
D production of a molecule of water

---

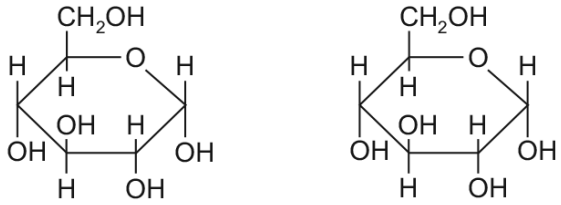
347. 9700_w16_qp_11 Q: 8

Which pair of monosaccharides forms sucrose?

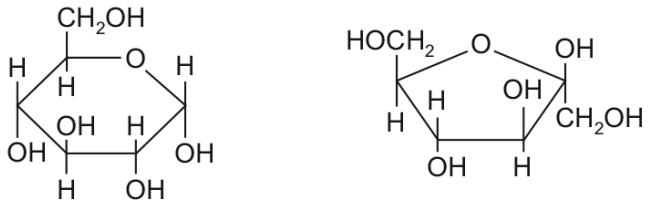
A



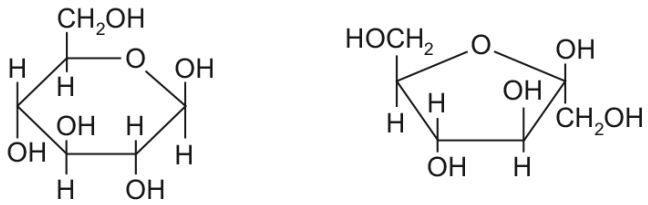
B



C

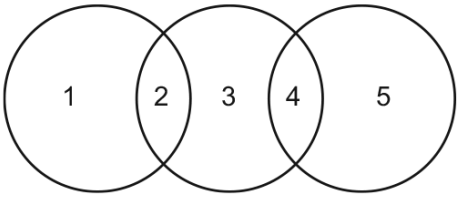


D



348. 9700_w16_qp_11 Q: 9

The diagram shows the relationship between different polysaccharides and the glycosidic bonds formed between the monomers.



Which row is correct?

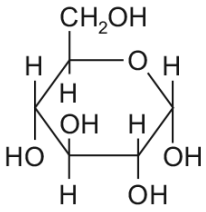
	1	2	3	4	5
A	amylopectin	α-1,6	cellulose	β-1,4	glycogen
B	amylose	α-1,4	glycogen	β-1,4	amylopectin
C	cellulose	β-1,4	amylose	α-1,4	glycogen
D	glycogen	α-1,6	amylopectin	α-1,4	amylose

---

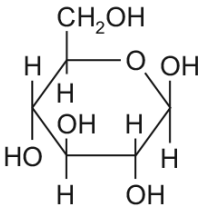
349. 9700_w16_qp_12 Q: 7

The diagrams show four monosaccharides with the formula $C_6H_{12}O_6$.

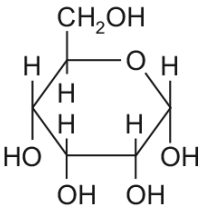
1



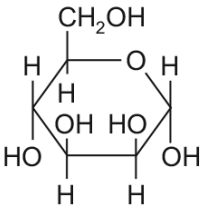
2



3



4



Which diagrams do **not** show glucose molecules?

A 1 and 2 **B** 1 and 4 **C** 2 and 3 **D** 3 and 4

---

350. 9700_w16_qp_12 Q: 8

Complete digestion of polysaccharides requires all the glycosidic bonds between the monomers to be broken.

Amylase breaks only α-1,4 glycosidic bonds.

How completely can amylase digest molecules of amylose, amylopectin or glycogen?

	carbohydrate		
	amylose	amylopectin	glycogen
A	+	+++	++
B	+	++	+++
C	++	+	+++
D	+++	++	+

key	
+	some digestion
++	more digestion
+++	most digestion

---

351. 9700_w16_qp_12 Q: 9

Which statements about a triglyceride molecule are correct?

1 It always contains unsaturated hydrocarbon tails.

2 It is formed using ester bonds.

3 It does not form hydrogen bonds.

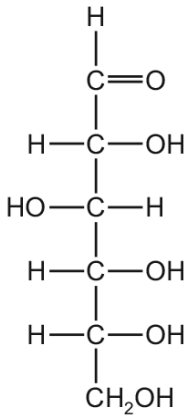
4 It contains a hydrophilic glycerol head.

A 1, 2 and 3 **B** 2, 3 and 4 **C** 1 and 4 only **D** 2 and 3 only

---

352. 9700_w16_qp_12 Q: 11

The ring structure of sugars can also be represented as a linear structure, as shown in the diagram.



Which of the sugar molecules could be represented by this formula?

1 β-glucose

2 ribose

3 sucrose

A 1 and 2 only **B** 2 and 3 only **C** 1 only **D** 2 only

353. 9700_w16_qp_13 Q: 7

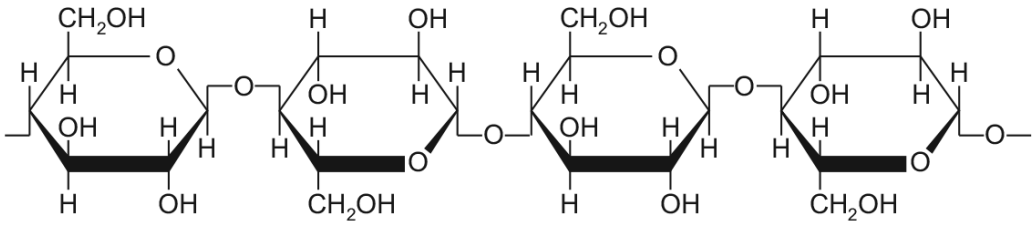
Which row is correct for each of the molecules?

	collagen	haemoglobin	sucrose
A	has a structural function, found in blood vessel walls	contains the elements carbon, hydrogen, iron, nitrogen and sulfur	formed by releasing a molecule of water in a hydrolysis reaction
B	molecules consist of three polypeptide chains, linked by ionic bonds	each non-protein haem group contains a central iron ion	composed of two monosaccharides linked by a glycosidic bond
C	molecules lie parallel to each other, with cross-links and staggered ends	has two identical α chains and two identical β chains	formed by condensation of two identical monosaccharides
D	polypeptide chains interact to produce a fibrous protein	has all four levels of protein structure and at least four types of bond	digestion yields glucose and fructose in equal proportions

---

354. 9700_w16_qp_13 Q: 8

The diagram shows how the β-glucose units of cellulose are linked to each other.



What is the significance of the fact that the OH groups on carbon 2 in adjacent glucose molecules are on opposite sides of the molecule?

A They can cross-link with other cellulose molecules by both hydrogen and glycosidic bonds.

B They can form glycosidic bonds with adjacent OH groups of other cellulose molecules.

C They can form hydrogen bonds between the CH_2OH and OH on adjacent glucose molecules of the cellulose molecule.

D They can form hydrogen bonds with adjacent OH and CH_2OH groups of other cellulose molecules.

---

355. 9700_s15_qp_11 Q: 9

Which row shows the correct match between the descriptions of biological molecules and where they are found?

1 a linear polymer of 1,4 linked β-glucose molecules

2 a bipolar, phosphate containing molecule

3 a highly branched polymer of 1,4 and 1,6 linked α-glucose molecules

	1	2	3
A	eukaryote and prokaryote cell walls	cell surface membranes of both eukaryotes and prokaryotes	forming storage granules in the cells of prokaryotes
B	eukaryote cell walls	cell surface membranes of both eukaryotes and prokaryotes	forming storage granules in the cells of some eukaryotes
C	eukaryote cell walls	cell surface membranes of both eukaryotes and prokaryotes	forming starch grains in the cells of all eukaryotes
D	forms storage granules in the cells of eukaryotes	prokaryote cell walls	eukaryote cell walls

---

356. 9700_s15_qp_11 Q: 10

Which is the correct description for the structure of amylose and cellulose?

	amylose	cellulose
A	α-glucose 180° rotation 1,4 and 1,6 linkages	β-glucose no rotation 1,4 linkages
B	α-glucose no rotation 1,4 linkages	β-glucose 180° rotation 1,4 linkages
C	α-glucose no rotation 1,4 linkages	α-glucose 180° rotation 1,4 and 1,6 linkages
D	β-glucose no rotation 1,4 linkages	α-glucose 180° rotation 1,4 linkages

---

357. 9700_s15_qp_12 Q: 10

Which bonds hold together the structure of cellulose?

1 glycosidic

2 hydrogen

3 ionic

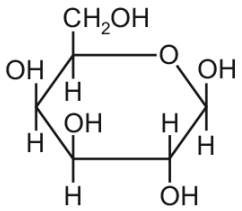
A 1, 2 and 3 **B** 1 and 2 only **C** 1 and 3 only **D** 2 and 3 only

---

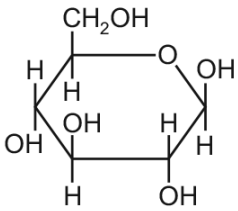
358. 9700_s15_qp_13 Q: 7

Which molecule is α-glucose?

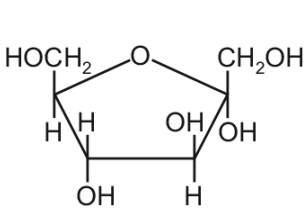
A



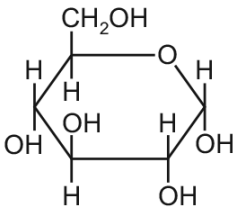
B



C



D

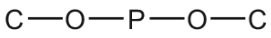


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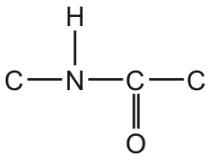
359. 9700_w15_qp_11 Q: 7

Which diagram shows the bond linking the individual units of both glycogen and amylose?

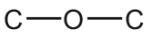
A



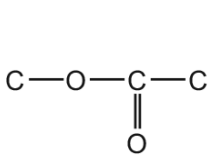
B



C



D



---

360. 9700_w15_qp_11 Q: 9

Which row describes a triglyceride?

	hydrophilic	insoluble in alcohol
A	✓	✓
B	✓	✗
C	✗	✓
D	✗	✗

key

✓ = correct

✗ = not correct

---

361. 9700_w15_qp_11 Q: 10

A solution containing equal masses of amylose and amylopectin is completely hydrolysed.

Which molecules will be found after the hydrolysis?

A α-glucose only

B β-glucose only

C equal masses of α-glucose and β-glucose

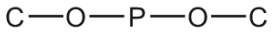
D more α-glucose than β-glucose

---

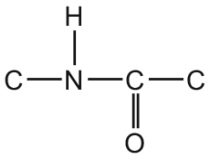
362. 9700_w15_qp_12 Q: 8

Which diagram shows the bond linking the individual units of both cellulose and glycogen?

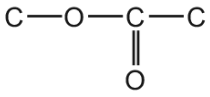
A



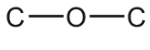
B



C



D



---

363. 9700_w15_qp_12 Q: 9

Which row describes a triglyceride?

	hydrophilic	soluble in alcohol
A	✓	✓
B	✓	✗
C	✗	✓
D	✗	✗

key

✓ correct

✗ not correct

---

364. 9700_w15_qp_13 Q: 8

The synthesis of biological molecules requires the formation of bonds.

Which row is correct?

	a bond forms between the phosphate of one monomer and the sugar of the next monomer	a β-1,4 bond forms between the monomers to give an unbranched chain	the hydroxyl group of the carboxylic acid group is removed and a carbon-nitrogen bond is formed to give an unbranched chain
A	polynucleotide	amylose	polypeptide
B	polynucleotide	cellulose	polypeptide
C	phospholipid	amylose	polynucleotide
D	phospholipid	cellulose	polynucleotide

---

365. 9700_w15_qp_13 Q: 9

Which row describes a triglyceride?

	hydrophobic	insoluble in alcohol
A	✓	✓
B	✓	✗
C	✗	✓
D	✗	✗

key

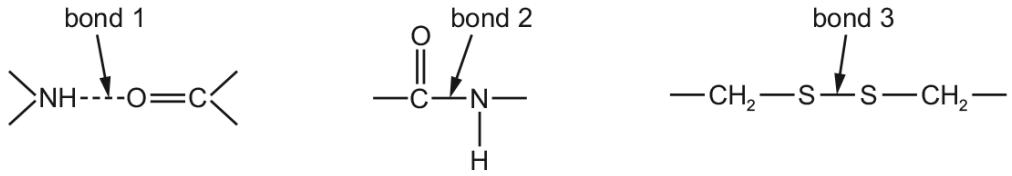
✓ correct

✗ not correct

2.3 Proteins and water

366. 9700_m20_qp_12 Q: 11

The diagrams show three examples of different bonds.



Which bonds hold the secondary structure of proteins together?

A 1, 2 and 3

B 1 and 2 only

C 1 only

D 2 and 3 only

---

367. 9700_m20_qp_12 Q: 12

Hydrogen bonding explains many of the properties of water, including the high latent heat of vapourisation and high specific heat capacity.

For which processes in plants is hydrogen bonding in water important on hot sunny days?

1 preventing denaturation of enzymes in leaves

2 reducing water loss by evaporation

3 allowing leaves to cool down quickly at night

4 holding the column of water in xylem vessels together

A 1, 2, 3 and 4

B 1, 2 and 4 only

C 1, 3 and 4 only

D 2 and 3 only

---

368. 9700_s20_qp_11 Q: 9

Which molecules contain at least two double bonds?

1 unsaturated fatty acid

2 collagen

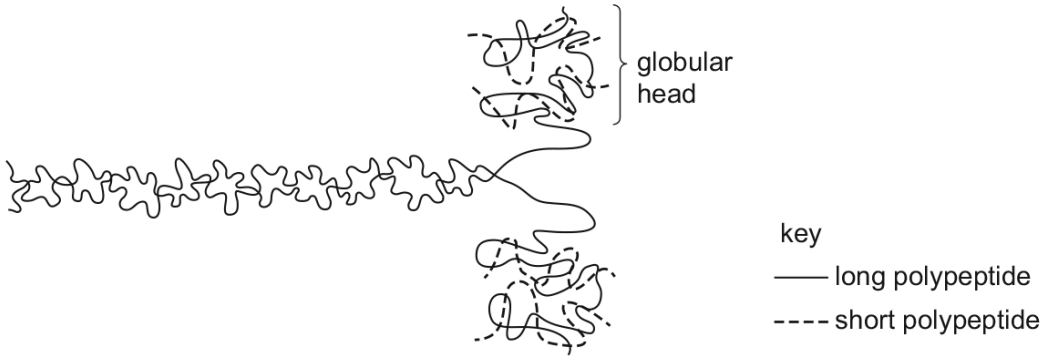
3 haemoglobin

A 1, 2 and 3 **B** 1 and 2 only **C** 1 and 3 only **D** 2 and 3 only

---

369. 9700_s20_qp_11 Q: 10

The diagram shows a protein molecule.



Two long polypeptides each form α-helices for much of their length and these twist together into a fibre.

At one end, each of these polypeptides coils into a globular head.

Two short polypeptides bind to each globular head.

What describes the protein structure of this molecule?

A quaternary structure because each molecule consists of six polypeptides

B secondary structure because the long polypeptides form α-helices

C tertiary structure because the α-helices form a fibre

D tertiary structure because the heads form globular proteins

---

370. 9700_s20_qp_11 Q: 11

Which types of bond will keep a folded protein in its precise shape for the longest time as the temperature rises?

A disulfide

B hydrogen

C hydrophobic interactions

D ionic

---

371. 9700_s20_qp_12 Q: 11

What occurs during the formation of a peptide bond between two amino acids?

A OH is removed from COOH and H is removed from an R group.

B OH is removed from COOH and H is removed from NH_2.

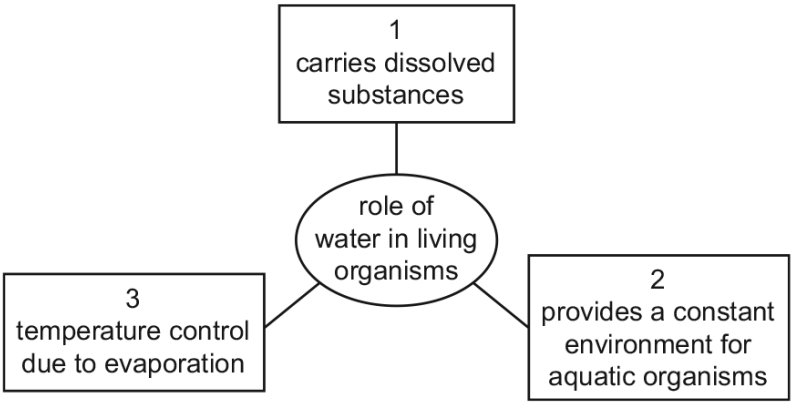
C H is removed from COOH and OH is removed from an R group.

D O is removed from COOH and 2H is removed from NH_2.

---

372. 9700_s20_qp_12 Q: 12

The diagram represents roles of water in living organisms.



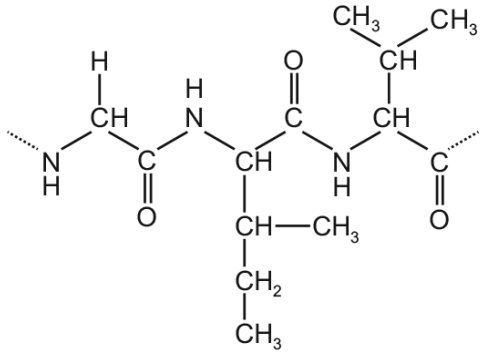
Which roles are dependent upon hydrogen bonds between water molecules?

A 1, 2 and 3 **B** 1 and 2 only **C** 1 and 3 only **D** 2 and 3 only

---

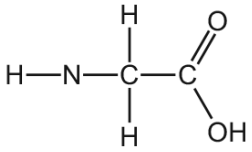
373. 9700_s20_qp_13 Q: 8

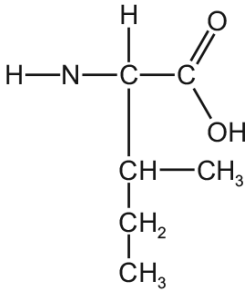
The diagram shows a small part of a polypeptide.

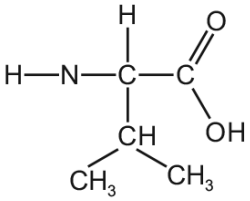


What would the products be if the part shown was completely hydrolysed?

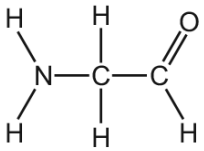
A

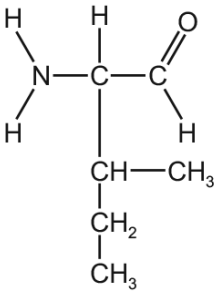


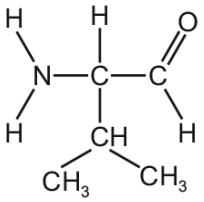




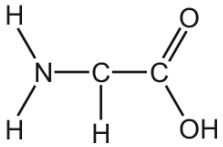
B

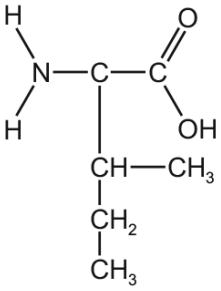


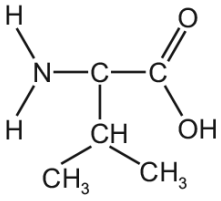




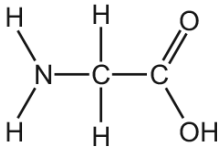
C

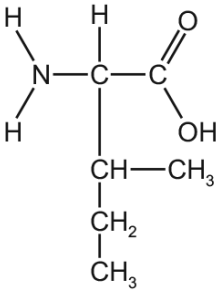


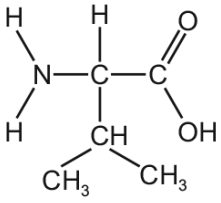




D







374. 9700_s20_qp_13 Q: 9

The enzyme trypsin hydrolyses proteins to amino acids. Trypsin does not function when the pH is very low as its 3D shape would be changed.

What explains this change in 3D shape?

A Hydrogen ions attach themselves to negatively charged R groups.

B Hydrogen ions disrupt disulfide bonds.

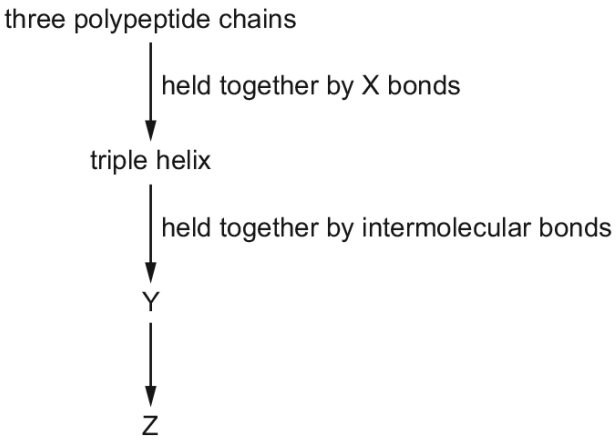
C Hydrogen ions increase hydrogen bonding between amino acids.

D Hydrogen ions reduce the affinity of hydrophilic R groups for water.

---

375. 9700_s20_qp_13 Q: 10

The flow chart shows some of the steps in the formation of collagen.



Which row correctly identifies X, Y and Z?

	X	Y	Z
A	disulfide	fibres	fibrils
B	hydrogen	fibrils	fibres
C	hydrogen	microfibrils	fibres
D	peptide and hydrogen	fibres	microfibrils

---

376. 9700_s20_qp_13 Q: 11

Which molecules contain at least two double bonds?

1 saturated fatty acid

2 collagen

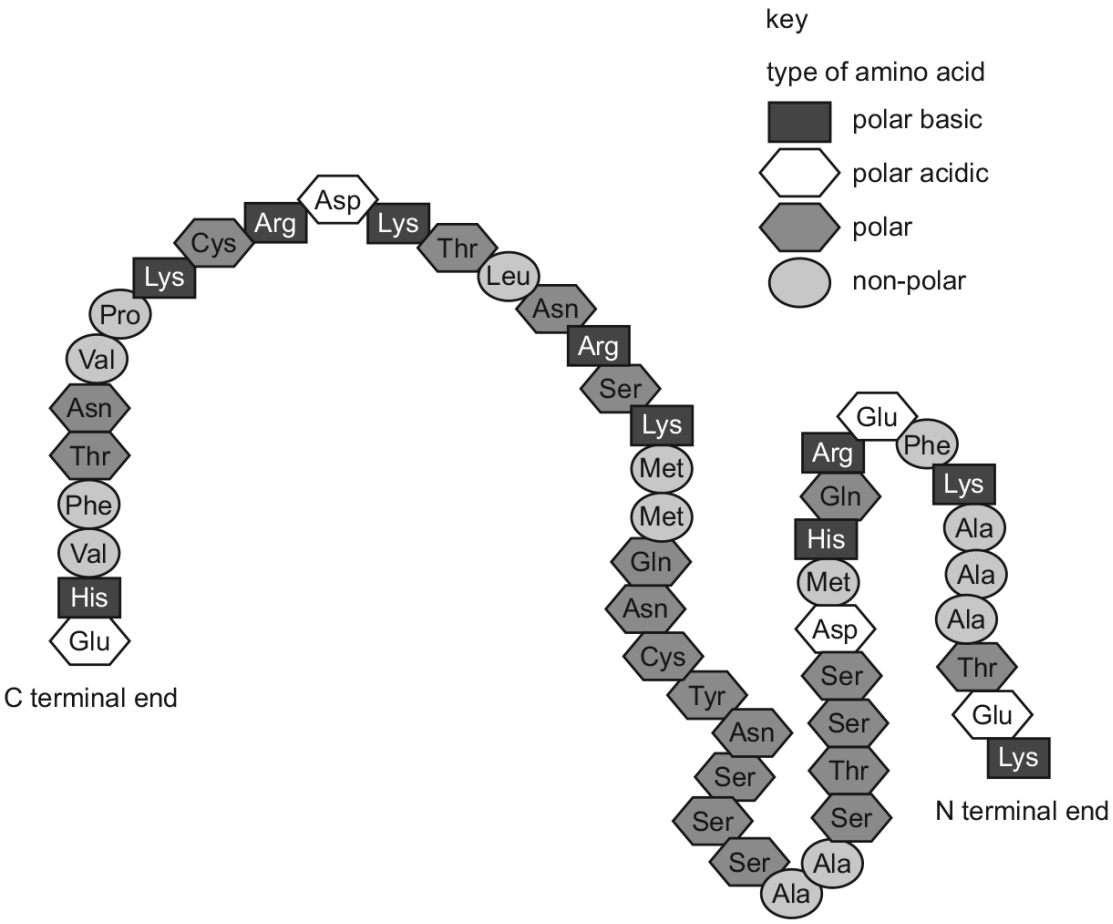
3 haemoglobin

A 1, 2 and 3 **B** 1 and 2 only **C** 1 and 3 only **D** 2 and 3 only

---

377. 9700_w20_qp_11 Q: 11

The diagram shows the amino acids in a polypeptide.



An enzyme catalyses the hydrolysis of **any** peptide bond between a non-polar amino acid **and** any polar amino acid.

How many small peptides and single amino acids will be formed by the action of this enzyme?

	small peptides	single amino acids
A	6	1
B	8	1
C	12	3
D	13	4

378. 9700_w20_qp_11 Q: 12

Which properties of water reduce temperature changes inside cells?

1 cohesion

2 latent heat of vaporisation

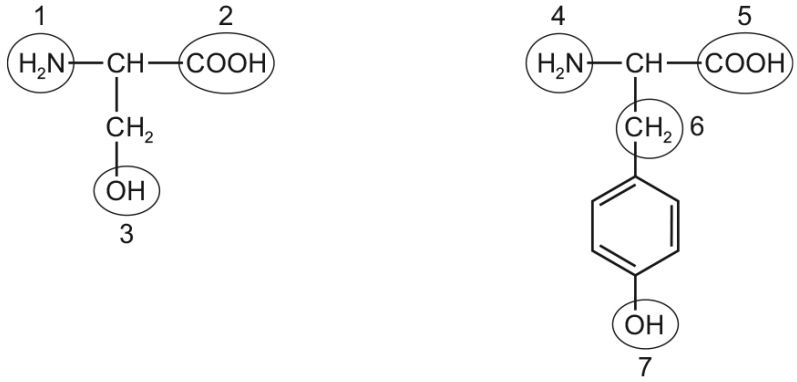
3 specific heat capacity

A 1 and 2 **B** 1 and 3 **C** 2 and 3 **D** 3 only

---

379. 9700_w20_qp_12 Q: 9

The diagram shows the structures of two amino acids.



These amino acids will form part of a protein that has a tertiary structure.

Which numbered groups could form hydrogen bonds to maintain the tertiary structure of the protein?

A 1 and 6 **B** 2 and 4 **C** 3 and 5 **D** 3 and 7

---

380. 9700_w20_qp_12 Q: 10

Which row about the structure of proteins is correct?

	primary structure	tertiary structure	quaternary structure
A	is the number of amino acids present in a protein	is the result of cross bonding between all the amino acids in the primary structure	is the polypeptides that link together to form a protein
B	is the order of amino acids present in a protein encoded by DNA	is the shape formed by folding of a polypeptide and held together by hydrogen bonds	contains two types of polypeptide that interact forming the shape of a protein
C	is the result of translation of an mRNA molecule by a ribosome into a chain of amino acids	is the result of ionic and hydrogen bonds, disulfide bridges and hydrophobic interactions between amino acids	is formed by four polypeptides and an additional reactive group attached to the protein
D	is the sequence of amino acids in a protein coded by an mRNA molecule	is formed as a result of interaction of the side chains of amino acids in the primary structure	is formed by the linking together of more than one polypeptide to form a protein

---

381. 9700_w20_qp_12 Q: 11

Which row correctly identifies structural features of a collagen molecule and a haemoglobin molecule?

	molecule consists of more than one polypeptide	globular protein
A	collagen and haemoglobin	collagen and haemoglobin
B	collagen and haemoglobin	haemoglobin only
C	haemoglobin only	collagen and haemoglobin
D	haemoglobin only	haemoglobin only

---

382. 9700_w20_qp_13 Q: 12

Adult human haemoglobin typically consists of two α chains and two β chains.

Approximately 5% of humans have one amino acid in the β chain that has been changed. This change affects the structure and stability of haemoglobin.

Which levels of protein structure could be affected in the haemoglobin of the humans with the changed amino acid?

A primary only

B primary and quaternary only

C secondary, tertiary and quaternary only

D primary, secondary, tertiary and quaternary

---

383. 9700_m19_qp_12 Q: 14

Which levels of protein structure can determine the specificity of an enzyme?

1 primary

2 secondary

3 tertiary

4 quaternary

A 1, 2, 3 and 4

B 1, 2 and 3 only

C 1, 2 and 4 only

D 3 and 4 only

---

384. 9700_s19_qp_11 Q: 12

What is the minimum number of carbon atoms in an amino acid?

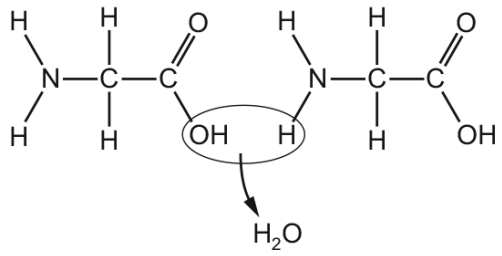
A 1 **B** 2 **C** 3 **D** 4

---

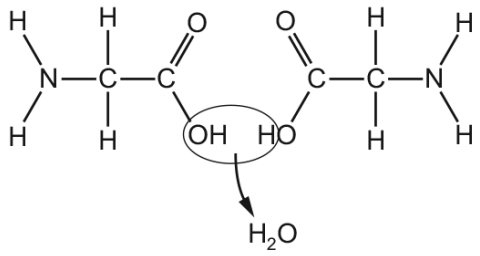
385. 9700_s19_qp_12 Q: 7

Which diagram shows the formation of a peptide bond?

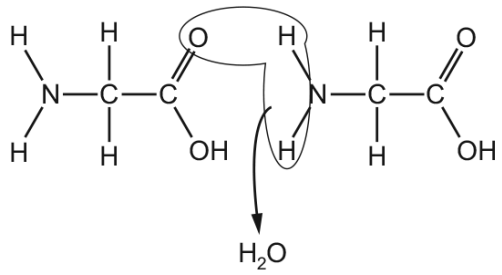
A



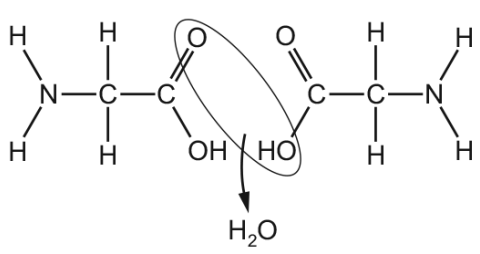
B



C



D



---

386. 9700_s19_qp_12 Q: 8

In enzyme-catalysed reactions, the position of the amino acids found at the active site is important.

During the synthesis of enzymes, amino acids are brought together in the correct position to form the active site.

Which levels of protein structure **must** be involved in forming the active site?

	level of protein structure			
	primary	secondary	tertiary	quaternary
A	✓	✓	✓	✓
B	✓	✓	✓	✗
C	✗	✓	✓	✓
D	✗	✓	✗	✓

key

✓ = involved

✗ = not involved

---

387. 9700_s19_qp_12 Q: 9

Which features affect the tensile strength of collagen?

1 the helical structure of collagen chains

2 the small R group of the amino acids in collagen

3 the insoluble nature of collagen

4 the bonds between collagen molecules

A 1, 2, 3 and 4

B 1, 2 and 4 only

C 1 and 3 only

D 2, 3 and 4 only

---

388. 9700_s19_qp_13 Q: 13

Which features of collagen result in it having high tensile strength?

1 Bonds form between adjacent molecules.

2 Each three-stranded molecule is held together by hydrogen bonds.

3 Every third amino acid in the polypeptide is small.

4 The primary structure is held together by peptide bonds.

A 1, 2 and 3 **B** 1, 3 and 4 **C** 1 and 2 only **D** 2, 3 and 4

---

389. 9700_s19_qp_13 Q: 14

Which levels of protein structure would always be changed if an enzyme works by the induced fit hypothesis?

	primary	secondary	tertiary	quaternary
A	✓	✓	✓	✓
B	✓	✓	✗	✗
C	✗	✓	✗	✗
D	✗	✗	✓	✗

key

✓ = always changed

✗ = not changed

---

390. 9700_w19_qp_11 Q: 11

Some foods contain hydrogenated vegetable oils. These are unsaturated fats that have been converted to saturated fats.

Which property of the fats will have changed?

A Their hydrocarbon chains will fit together more closely.

B Their solubility in water will increase.

C They will have more double bonds in their molecules.

D They will remain liquid at room temperature.

---

391. 9700_w19_qp_11 Q: 12

Which statements could be used to describe enzyme molecules **and** antibody molecules?

1 Hydrogen bonds stabilise the structure of the protein and are important for it to function efficiently.

2 Hydrophilic R-groups point in to the centre of the molecule and cause it to curl into a spherical shape.

3 The tertiary structure of the protein molecule plays an important role in the functioning of the protein.

A 1, 2 and 3 **B** 1 and 2 only **C** 1 and 3 only **D** 2 and 3 only

---

392. 9700_w19_qp_12 Q: 9

Which rows show the chemical groups present in the biological molecules listed?

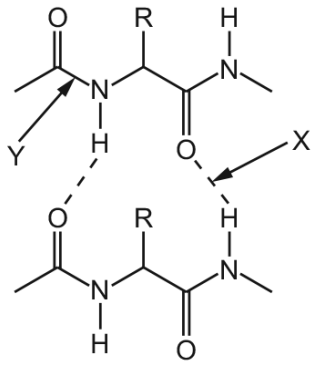
	biological molecule	presence of carboxyl (COOH) groups	presence of two or more hydroxyl (OH) groups
1	amino acid	yes	no
2	β-glucose	no	yes
3	glycerol	no	no
4	fatty acid	yes	no

A 1, 2 and 3 **B** 1, 2 and 4 **C** 1, 3 and 4 **D** 2, 3 and 4

---

393. 9700_w19_qp_12 Q: 11

Fibrous proteins are composed of chains of amino acids held together by bonds. An example of part of a fibrous protein is shown.



Which type of bond is at X and Y?

	X	Y
A	disulfide	hydrophobic interaction
B	hydrogen	peptide
C	hydrophobic interaction	ionic
D	ionic	peptide

394. 9700_w19_qp_12 Q: 12

Which row about the structure of proteins is correct?

	primary structure	secondary structure	quaternary structure
A	is the number of amino acids present in a protein	is the left-handed spiral formed by the primary structure	is the sub-unit polypeptides that link together to form a protein
B	is the order of amino acids present in a protein encoded by DNA	is the coiling of a chain of amino acids to form a β-pleated sheet or α-helix	contains two types of polypeptide that interact forming the shape of a protein
C	is the result of translation of an mRNA molecule by a ribosome into a chain of amino acids	occurs because of attraction between hydrogen and oxygen atoms in the peptide bonds	is formed by four polypeptides and an additional reactive group attached to the protein
D	is the sequence of amino acids in a protein coded by an mRNA molecule	is formed by hydrogen bonding between amino acids forming the primary structure	is formed by the linking together of more than one polypeptide to form a protein

---

395. 9700_w19_qp_12 Q: 13

A student wrote four statements about water.

1 Water has a high specific heat capacity which maintains the temperature of water within cells.

2 Mammals rely on water having a relatively low latent heat of vapourisation to keep them cool.

3 When a negatively charged ion is added to water, the δ^+ charge on the hydrogen atom is attracted to the ion.

4 When surrounded by water, non-polar molecules tend to be pushed apart from one another.

Which statements are correct?

	1	2	3	4
A	✓	✗	✓	✓
B	✓	✗	✓	✗
C	✗	✓	✗	✓
D	✗	✓	✗	✗

key

✓ = correct

✗ = not correct

---

396. 9700_w19_qp_13 Q: 9

Three proteins that have a quaternary structure are listed.

- Type IX collagen is formed from three different polymers.
- The main form of haemoglobin contains two alpha globins and two beta globins.
- HIV protease consists of two identical polymers.

Which row shows the correct number of genes needed to code for each protein?

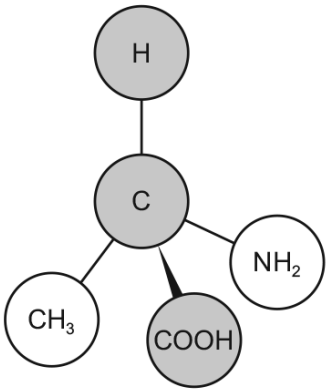
	number of genes		
	type IX collagen	haemoglobin	HIV protease
A	1	2	2
B	1	4	1
C	3	2	1
D	3	4	2

397. 9700_w19_qp_13 Q: 10

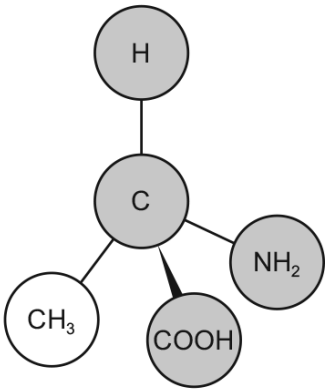
The diagrams show the structure of an amino acid with some parts of the molecule shaded.

Which diagram shows the shaded part of the molecule that is common to all amino acids?

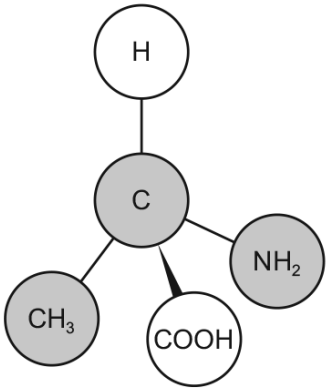
A



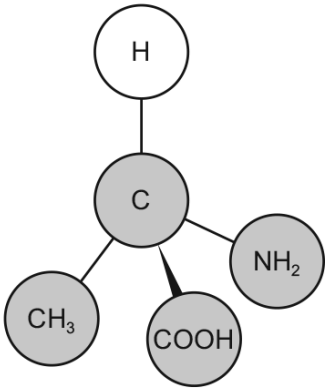
B



C



D



---

398. 9700_w19_qp_13 Q: 11

Some extracellular protease enzymes are synthesised in an inactive form called zymogen.

Zymogen is converted to the active protease in the Golgi body.

What is the purpose of producing zymogen before converting it to the extracellular protease?

A to avoid unwanted digestion of proteins inside the cell

B to avoid unwanted digestion of proteins outside the cell

C to catalyse digestion of proteins in the cytoplasm

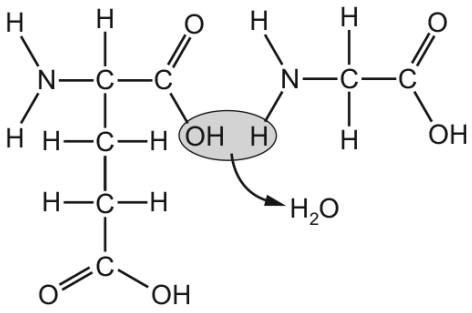
D to catalyse digestion of proteins in the rough endoplasmic reticulum

---

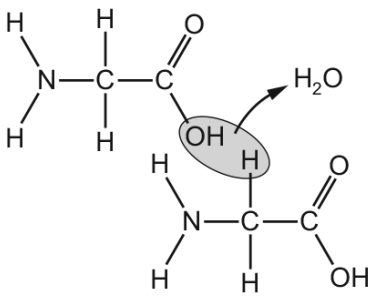
399. 9700_m18_qp_12 Q: 9

Which diagram correctly shows the formation of a peptide bond between two amino acids?

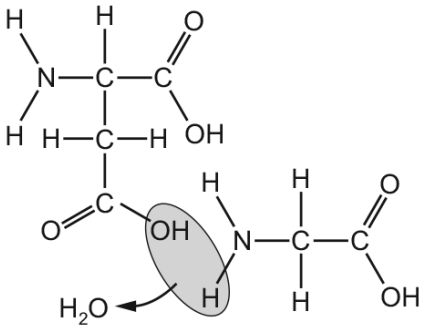
A



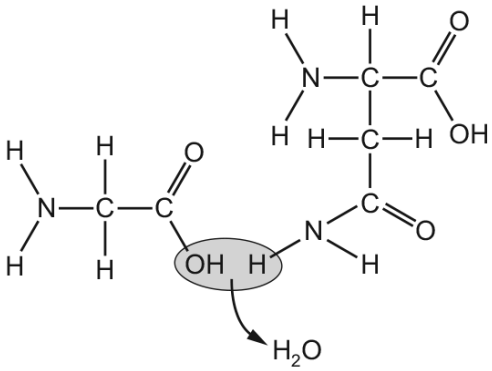
B



C



D



---

400. 9700_m18_qp_12 Q: 11

Which molecules are globular proteins?

1 amylase

2 haemoglobin

3 DNA polymerase

A 1, 2 and 3 **B** 1 and 2 only **C** 1 and 3 only **D** 2 only

---

401. 9700_m18_qp_12 Q: 12

When hydrolysed, which molecules have products containing a carboxyl group?

1 phospholipids

2 polysaccharides

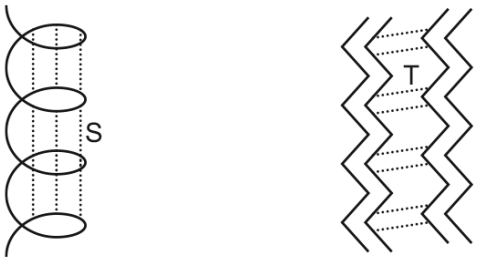
3 proteins

A 1 and 2 **B** 1 and 3 **C** 2 and 3 **D** 3 only

---

402. 9700_s18_qp_11 Q: 10

The diagrams show two arrangements of amino acids in a protein.



Which row correctly names the bonds at S or T?

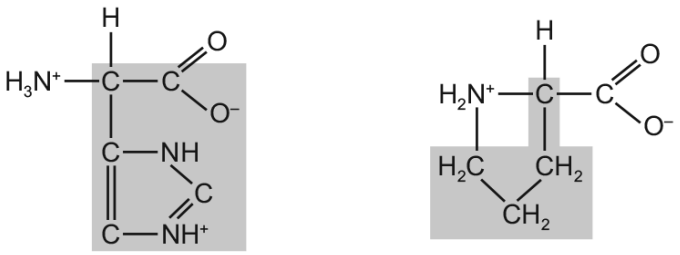
	ionic bond	hydrogen bond
A	absent	S and T
B	S only	T only
C	S and T	absent
D	T only	S and T

403. 9700_s18_qp_11 Q: 11

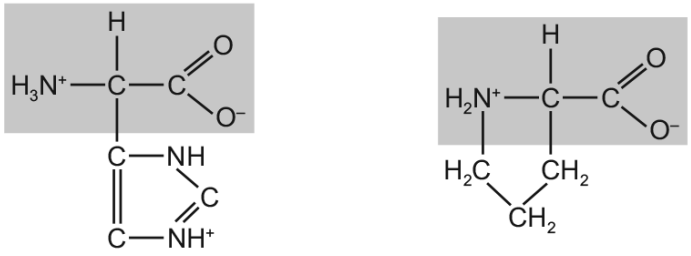
Students were asked to highlight only the R groups of two ring-shaped amino acids.

Which pair of diagrams are correct for both amino acids?

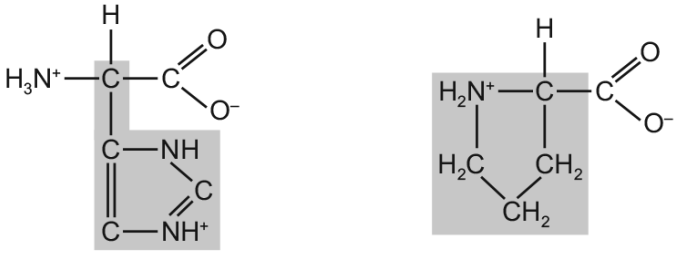
A



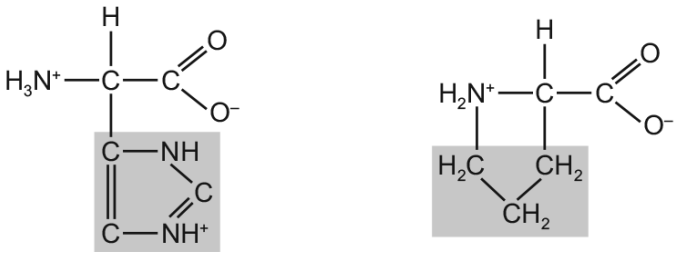
B



C



D



404. 9700_s18_qp_12 Q: 10

Which molecules contain C=O bonds?

1 amino acids

2 fatty acids

3 glycerol

A 1, 2 and 3 **B** 1 and 2 only **C** 1 and 3 only **D** 2 and 3 only

---

405. 9700_s18_qp_12 Q: 11

Which row describes a collagen molecule?

	bonds stabilising the molecule	properties	primary structure	helix
A	disulfide	high temperatures increase flexibility	high proportion of glycine	double
B	disulfide	resistant to stretching	repeat sequences of three amino acids	single
C	hydrogen	high tensile strength	repeat sequences of three amino acids	triple
D	hydrogen	insoluble in water	high proportion of glycine and proline	alpha

---

406. 9700_s18_qp_13 Q: 11

Which description is correct for collagen?

A A collagen molecule has a high proportion of the amino acid glycine, which has a very small R group.

B A group of three collagen fibres forms a strong, insoluble coiled structure termed a triple helix.

C Each of the collagen polypeptides in a collagen molecule has a regular spiral arrangement of many alpha helices.

D Peptide bonds are present between amino acids of the different polypeptides forming the collagen molecule.

---

407. 9700_s18_qp_13 Q: 12

Which statement about the properties of water is correct?

A Bonds between hydrogen atoms cause water to have a high specific heat capacity.

B The high latent heat of vaporisation of water is due to the presence of hydrogen bonds.

C The high specific heat capacity of water causes cooling during evaporation.

D Water can dissolve amylopectin as it has hydrophilic side chains.

---

408. 9700_w18_qp_11 Q: 11

Which statements about a peptide bond are correct?

1 It joins two monomers which are always identical to each other.

2 It contains four different atoms.

3 It can be broken by the addition of water at room temperature.

4 It is important in the primary structure of proteins.

A 1, 2 and 3 **B** 1 and 3 only **C** 2, 3 and 4 **D** 2 and 4 only

---

409. 9700_w18_qp_11 Q: 12

Which statements about the primary structure of a protein are correct?

1 It may be branched.

2 It is determined by the sequence of DNA bases.

3 It is unique to that protein.

4 It determines the tertiary structure of the protein.

A 1, 2 and 3 **B** 1, 2 and 4 **C** 1, 3 and 4 **D** 2, 3 and 4

---

410. 9700_w18_qp_11 Q: 13

A mutation occurred within the DNA sequence coding for an enzyme, causing a decrease in the rate of a reaction catalysed by this enzyme.

Which statements could explain the decrease in the rate of reaction?

1 An inhibitor for this enzyme has an increased affinity for the enzyme and forms an enzyme–inhibitor complex more easily.

2 The active site of the enzyme might have changed shape and so is no longer complementary.

3 The activation energy for the reaction with the mutated enzyme is greater than with the non-mutated enzyme.

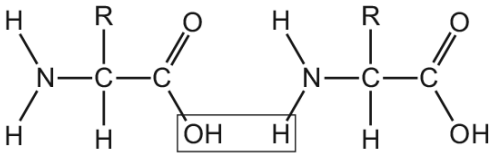
A 1, 2 and 3 **B** 1 and 2 only **C** 1 and 3 only **D** 2 and 3 only

---

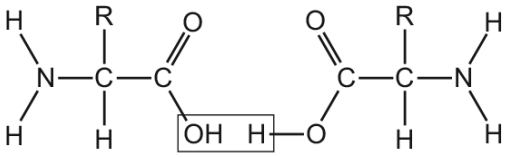
411. 9700_w18_qp_12 Q: 10

Which diagram shows where a peptide bond would be formed?

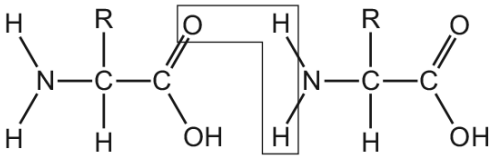
A



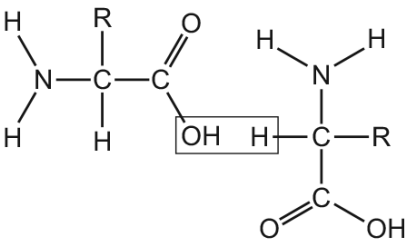
B



C



D



---

412. 9700_w18_qp_12 Q: 11

Which statements about collagen molecules are correct?

1 Both types of secondary structure occur within the molecules.

2 Large numbers of hydrogen bonds stabilise the molecules.

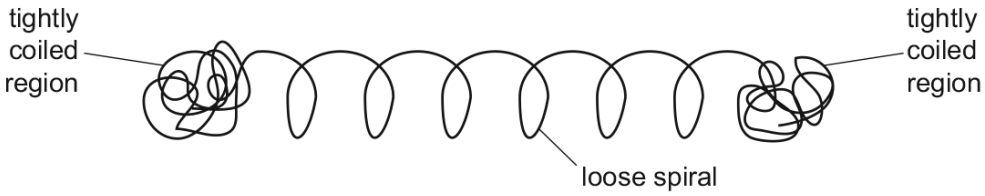
3 Repeated amino acid sequences determine the tertiary structure.

A 1, 2 and 3 **B** 1 and 2 only **C** 1 and 3 only **D** 2 and 3 only

---

413. 9700_w18_qp_12 Q: 12

The protein glutenin gives bread dough its elasticity. The diagram represents a polypeptide of glutenin.



What describes the structure of glutenin?

A quaternary structure because there are both globular and fibrous regions

B quaternary structure because there are both spiral and tightly coiled regions

C secondary structure because the loose spiral is an α-helix

D tertiary structure because the different regions form a 3D shape

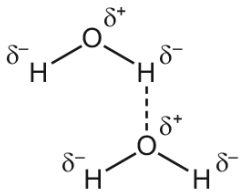
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414. 9700_w18_qp_12 Q: 13

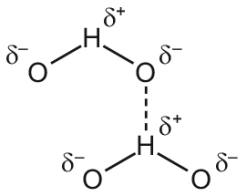
Which diagram correctly shows hydrogen bonding between water molecules?

The symbol δ indicates the partial charge on an atom in the water molecule.

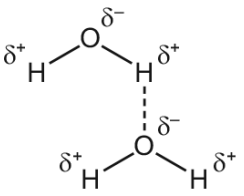
A



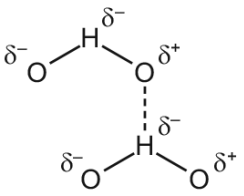
B



C



D



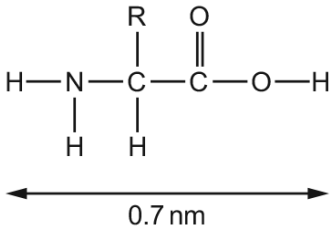
---

415. 9700_w18_qp_13 Q: 12

The table shows the diameter of some atoms when they form bonds.

atom	single bond / nm	double bond / nm
H	0.060	–
O	0.132	0.110
N	0.140	0.120
C	0.154	0.134

The approximate length of the amino acid shown was estimated using the figures in the table.



What would be the approximate length of a dipeptide formed using this amino acid?

A 0.9 nm **B** 1.2 nm **C** 1.4 nm **D** 1.7 nm

---

416. 9700_w18_qp_13 Q: 14

Some animals produce antimicrobial proteins which protect them from pathogens. These proteins could be used to kill human pathogens, however when used as a medicine they are broken down by protein-digesting enzymes.

Replacing one of the amino acids found in the protein with one that had been synthesised in the laboratory resulted in a modified protein that was not broken down.

What could explain why this modified protein was not broken down by the protein digesting enzymes?

1 The modified protein has a different tertiary structure to the original protein.

2 The modified protein is not complementary in shape to the enzyme's active site.

3 The modified protein is unable to induce a fit with the protein digesting enzyme.

A 1, 2 and 3 **B** 1 and 2 only **C** 2 and 3 only **D** 2 only

---

417. 9700_m17_qp_12 Q: 10

Some of the molecules found in animal tissues are grouped into three lists.

1 glucose, cholesterol, triglycerides, water

2 glycogen, antibodies, adenine, phospholipids

3 haemoglobin, carbon dioxide, mRNA, monosaccharides

Which lists include one or more molecules that always contain nitrogen atoms?

A 1, 2 and 3 **B** 1 and 2 only **C** 1 and 3 only **D** 2 and 3 only

---

418. 9700_m17_qp_12 Q: 11

Haemoglobin consists of two α chains and two β chains. Approximately 5% of all humans have one amino acid in the β chain that has been changed, affecting the structure and stability of haemoglobin.

Which of the levels of protein structure could be changed in the haemoglobin of these humans?

A primary only

B primary and quaternary only

C primary, secondary, tertiary and quaternary

D secondary, tertiary and quaternary only

---

419. 9700_m17_qp_12 Q: 12

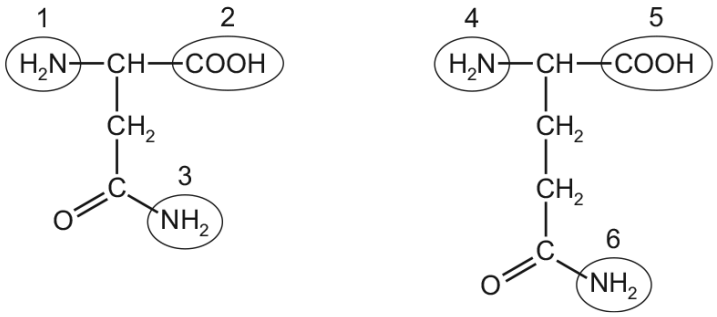
Which row gives the correct description of **both** a collagen molecule and a collagen fibre?

	collagen molecule	collagen fibre
A	α and β polypeptide chains forming a double helix, held together by disulfide bonds	molecules of collagen arranged randomly to each other, linked by hydrogen bonds
B	a polypeptide chain, with repeating amino acids, forming an α-helix	three molecules of collagen, forming a triple helix, held together by hydrogen bonds
C	a polypeptide chain, with three repeating amino acids, forming a helix	three α helical collagen molecules, forming a triple helix, held together by ionic bonds
D	three helical polypeptide chains, forming a triple helix, held together by hydrogen bonds	molecules of collagen lying parallel and cross-linked to each other

---

420. 9700_m17_qp_12 Q: 13

The diagrams show the structures of two amino acids, each of which has two amine ($-NH_2$) groups.



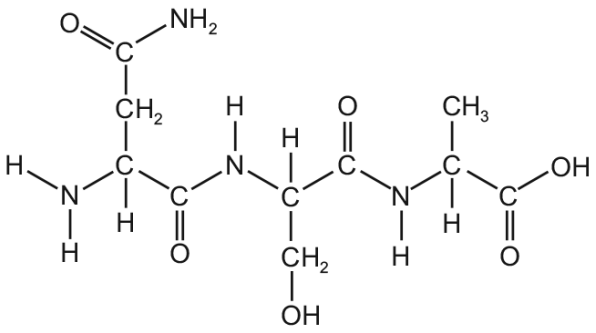
A peptide bond is formed between the two amino acids.

Which groups could form the peptide bond?

A 1 and 4 **B** 1 and 5 **C** 2 and 6 **D** 3 and 5

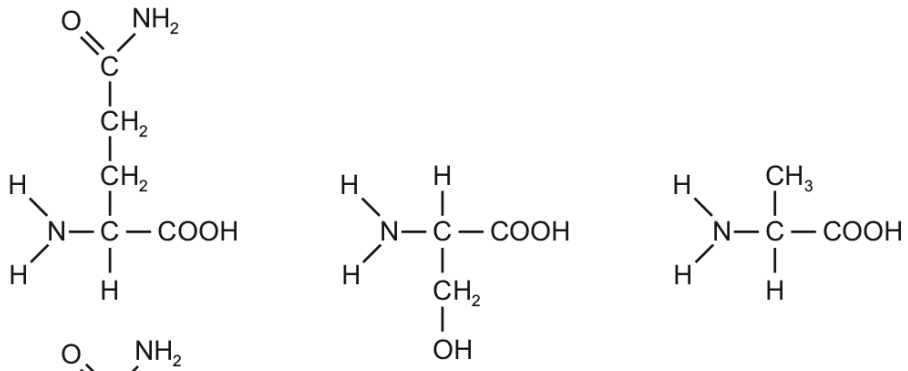
421. 9700_s17_qp_11 Q: 11

The diagram shows the molecular structure of a peptide.

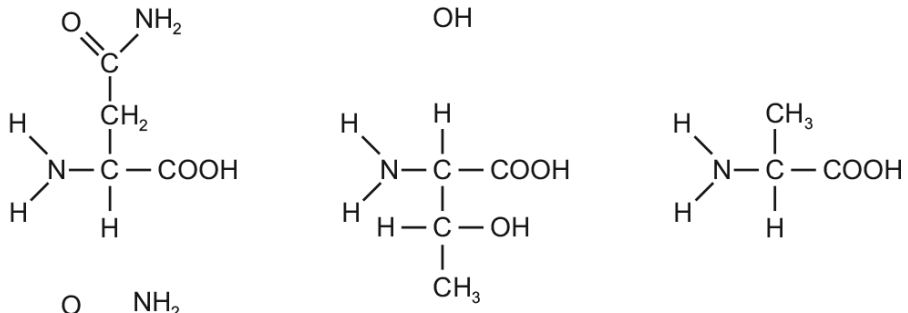


Which molecules would result from the complete hydrolysis of the peptide?

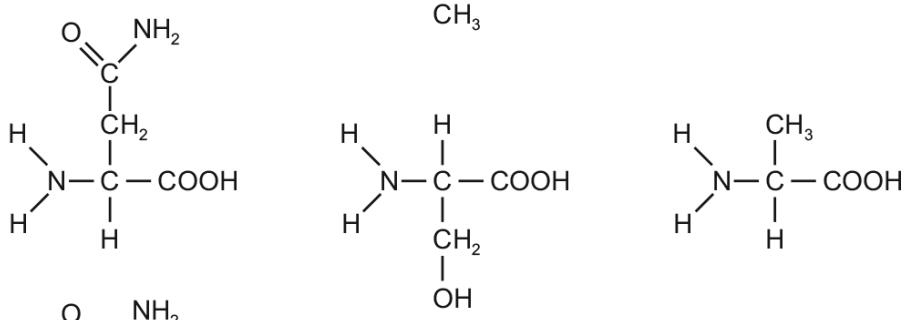
A



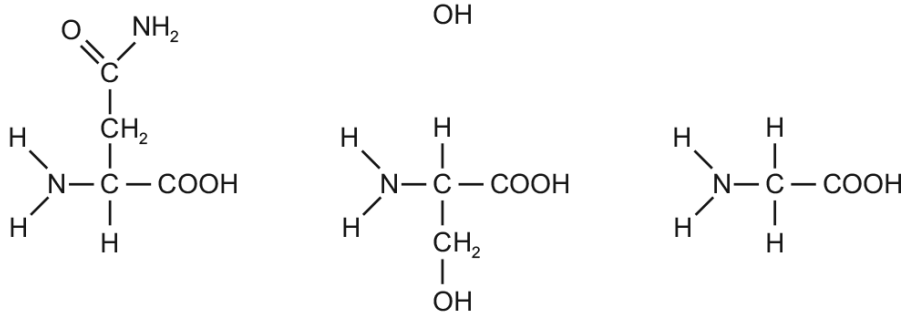
B



C

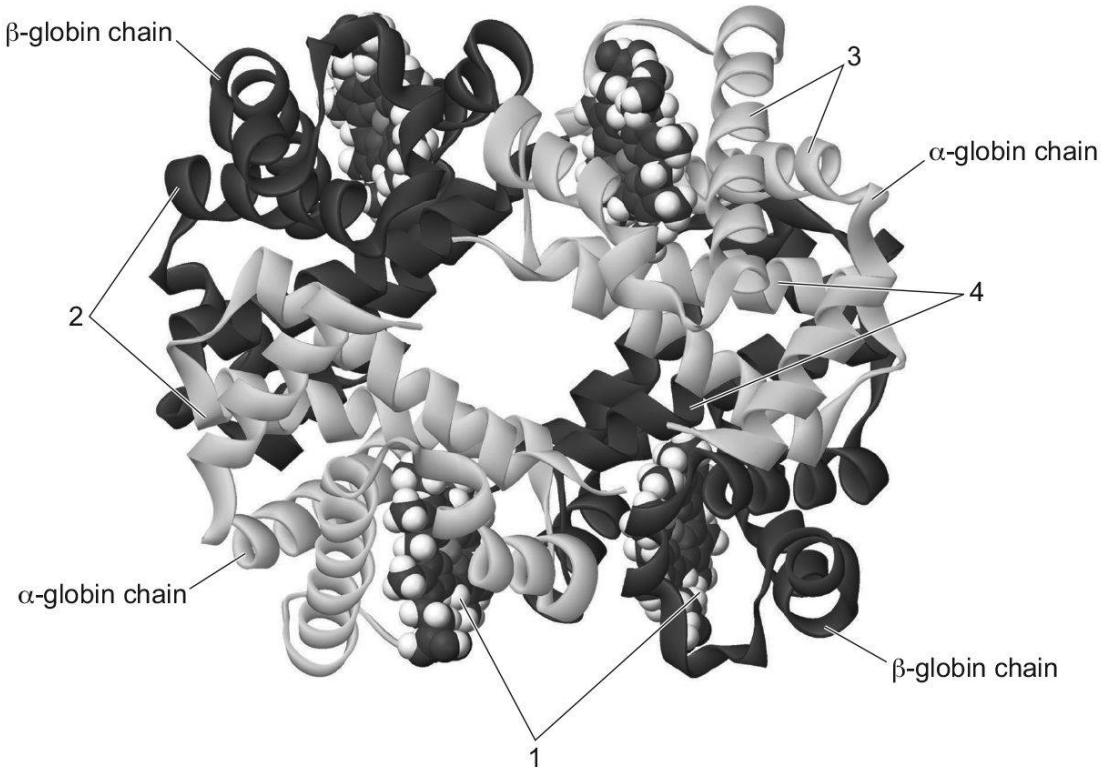


D



422. 9700_s17_qp_11 Q: 12

The diagram shows a haemoglobin molecule.



Which row identifies the different parts of the molecule?

	1	2	3	4
A	α-helix	β-pleated sheet	binding site	hydrophobic amino acids
B	binding site	hydrophilic amino acids	α-helix	hydrophobic amino acids
C	haem group	hydrophobic amino acids	α-helix	hydrophilic amino acids
D	hydrophobic amino acids	β-pleated sheet	haem atom	binding site

423. 9700_s17_qp_12 Q: 5

Boiling the bones and teeth from dead animals can be used to produce a type of glue.

The glue is formed from the collagen fibres present in bones and teeth.

Which statement describes the changes to collagen that occur when the glue is produced?

A The fibres of collagen become more coiled.

B The fibres of collagen become more flexible.

C The helices of collagen molecules unwind.

D The molecules of collagen dissolve in water.

---

424. 9700_s17_qp_12 Q: 6

What describes the primary structure of a protein?

A α-helix

B a dipeptide

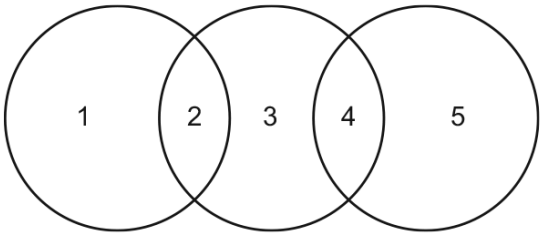
C a globular structure

D the specific order of amino acids

---

425. 9700_s17_qp_13 Q: 7

The diagram shows some of the relationships between cellulose, collagen and haemoglobin.



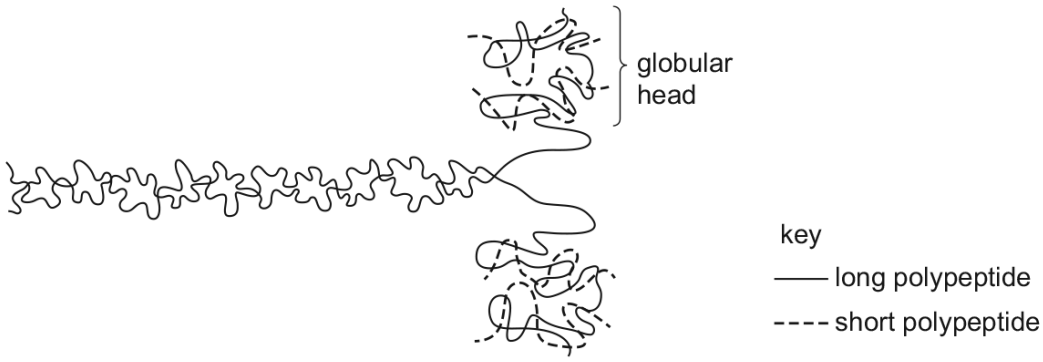
Which row is correct?

	1	2	3	4	5
A	cellulose	carbohydrate	collagen	protein	haemoglobin
B	cellulose	fibrous	haemoglobin	structural	collagen
C	haemoglobin	globular	cellulose	carbohydrate	collagen
D	haemoglobin	protein	collagen	structural	cellulose

---

426. 9700_s17_qp_13 Q: 8

The diagram shows a protein molecule.



Two long polypeptides each form α-helices for much of their length and these twist together into a fibre.

At one end, each of these polypeptides coils into a globular head.

Two short polypeptides bind to each head.

What describes the protein structure of this molecule?

A quaternary structure because each molecule consists of six polypeptides

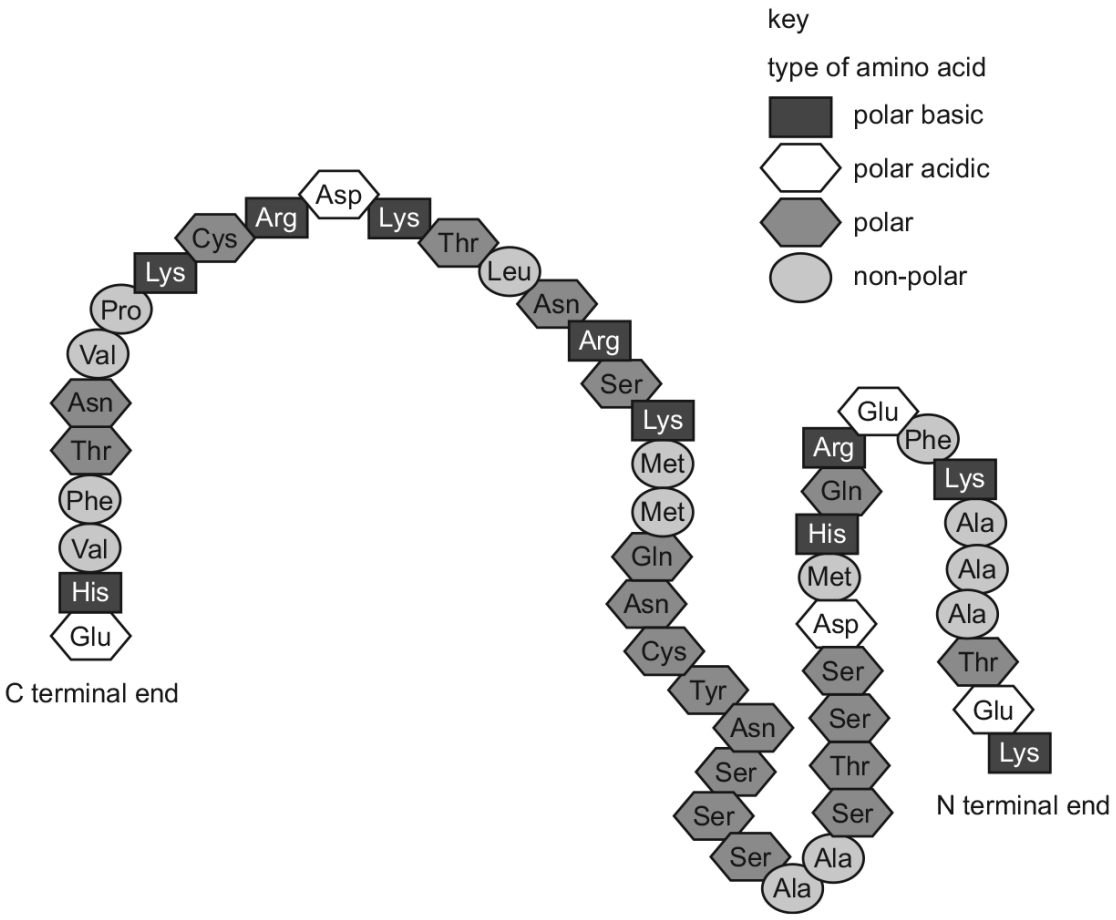
B secondary structure because the long polypeptides form α-helices

C tertiary structure because the α-helices form a fibre

D tertiary structure because the heads form globular proteins

427. 9700_w17_qp_11 Q: 9

The diagram shows the amino acids in a polypeptide.



An enzyme catalyses the hydrolysis of bonds between polar basic amino acids and non-polar amino acids.

How many peptides (chains of amino acids) will be formed as the result of the hydrolysis of this polypeptide?

A 5 **B** 6 **C** 8 **D** 13

---

428. 9700_w17_qp_11 Q: 10

Lysozyme is an enzyme found in tears and saliva.

Which statement refers only to the tertiary structure of lysozyme?

A A section of the molecule consists of an α-helix.

B It consists of a single polypeptide.

C It is 129 amino acids long.

D The 35th and 52nd amino acids help form the active site.

---

429. 9700_w17_qp_12 Q: 11

Which row correctly matches the functional and structural features of cellulose, collagen, glycogen or triglyceride?

	molecule	function	structure		
			fibrous	molecules held together by hydrogen bonds	branched chains
A	cellulose triglyceride	support energy source	✓ ✗	✓ ✗	✗ ✗
B	collagen cellulose	strengthening support	✓ ✓	✓ ✗	✗ ✓
C	collagen glycogen	strengthening storage	✓ ✗	✓ ✗	✓ ✓
D	glycogen triglyceride	storage energy source	✗ ✗	✓ ✓	✓ ✗

key ✓ = true ✗ = false

---

430. 9700_w17_qp_12 Q: 12

A polypeptide has a number of amino acids (*n*).

How many peptide bonds and R groups (side chains) does this polypeptide have?

A *n* – 1 peptide bonds and *n* – 1 R groups

B *n* – 1 peptide bonds and *n* R groups

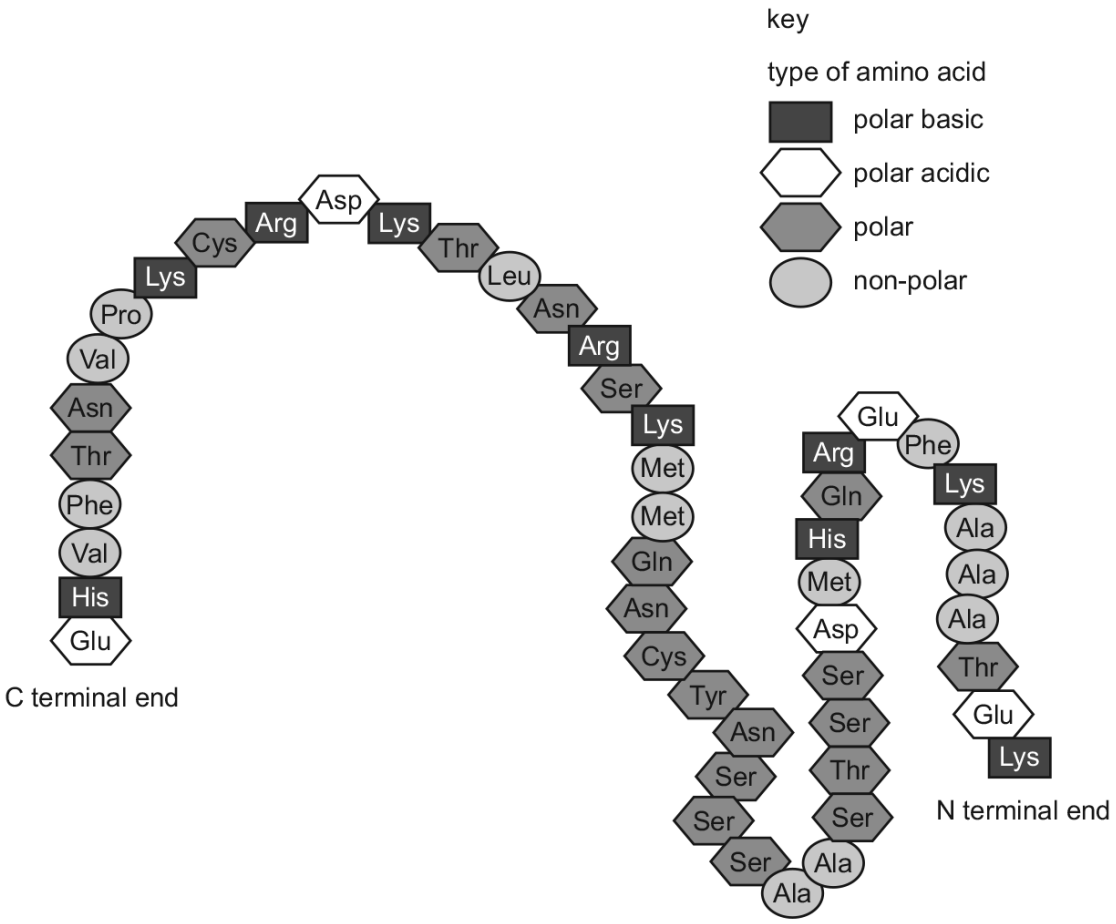
C *n* peptide bonds and *n* – 1 R groups

D *n* peptide bonds and *n* R groups

---

431. 9700_w17_qp_13 Q: 9

The diagram shows the amino acids in a polypeptide.



An enzyme catalyses the hydrolysis of **any** peptide bond between a non-polar amino acid **and** any polar amino acid.

How many small peptides and single amino acids will be formed by the action of this enzyme?

	small peptides	single amino acids
A	6	1
B	8	1
C	12	3
D	13	4

432. 9700_w17_qp_13 Q: 10

A person with diabetes is unable to make enough of the protein insulin.

Some forms of diabetes can be treated by using insulin produced by animals. Scientists have compared the amino acids in insulin produced by animals to human insulin.

Which level of protein structure were the scientists studying?

A primary

B secondary

C tertiary

D quaternary

---

433. 9700_w17_qp_13 Q: 12

Which levels of protein structure are maintained by disulfide bonds?

A secondary, tertiary and quaternary

B tertiary and quaternary only

C quaternary only

D tertiary only

---

434. 9700_m16_qp_12 Q: 10

When proteins are mixed with some organic solvents, hydrophobic interactions and hydrogen bonding are changed in the protein molecules.

Which levels of protein structure would be affected?

	level of protein structure		
	secondary	tertiary	quaternary
A	✓	✓	✗
B	✓	✗	✓
C	✗	✓	✓
D	✓	✓	✓

key

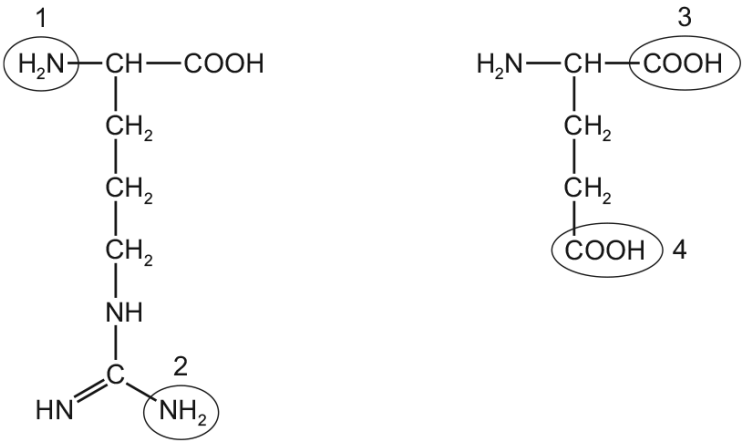
✓ = affected

✗ = not affected

---

435. 9700_s16_qp_11 Q: 10

The diagrams show the structures of two amino acids, one of which has two amine ($–NH_2$) groups and the other has two carboxylic (–COOH) groups.



A peptide bond is formed between the two amino acids.

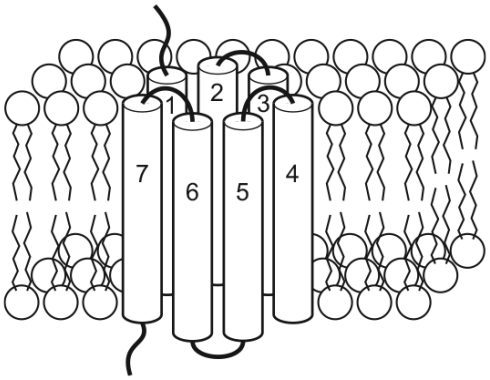
Which groups form the peptide bond?

A 1 and 3 **B** 2 and 3 **C** 2 and 4 **D** 4 and 1

---

436. 9700_s16_qp_11 Q: 11

Proteins which transport sugars out of cells have been identified. These proteins are called SWEETs. Each SWEET has seven coiled, cylindrical regions which together make up a pore through the cell surface membrane bilayer, as shown in the diagram.



What describes each of the seven coiled regions (1-7) of a SWEET shown in the diagram?

A primary structure held in its shape by bonds such as hydrogen bonds

B primary structure held in its shape by peptide bonds

C secondary structure held in its shape by bonds such as hydrogen bonds

D secondary structure held in its shape by peptide bonds

---

437. 9700_s16_qp_12 Q: 7

Which statement about the quaternary structure of proteins is correct?

A consists of four subunits

B depends on the presence of metal ions

C depends on the primary structure of the subunits

D is made of α and β subunits

---

438. 9700_s16_qp_12 Q: 8

Which set of statements correctly describes haemoglobin?

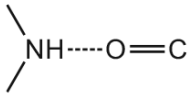
A	four polypeptide chains, each containing a haem group	iron ions can associate with oxygen forming oxyhaemoglobin	in each chain, hydrophobic R groups of amino acids point towards the centre of the molecule	at 50 % saturation, two oxygen molecules are transported by the molecule
B	polypeptide chains interact to produce a globular chain	each chain contains a haem group of amino acids surrounding an iron ion	consists of two identical alpha chains and two identical beta chains	each chain can transport an oxygen molecule
C	polypeptide chains interact to produce an almost spherical molecule	an iron ion is present within each haem group	quaternary structure has two alpha chains and two beta chains	each molecule can transport a total of four oxygen atoms
D	polypeptide chains produce a loose helical shape, which folds to form a spherical molecule	iron ions in the molecule can bind reversibly with oxygen	in each chain, hydrophobic R groups of amino acids surround the iron ion	each molecule can transport a total of eight oxygen atoms

---

439. 9700_s16_qp_12 Q: 9

The diagrams show different types of bond found in biological molecules.

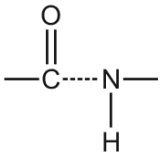
1



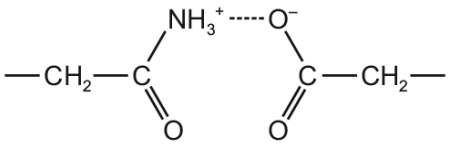
2



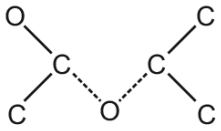
3



4



5



Which bonds are found in proteins with a tertiary structure?

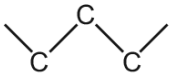
A 1, 2, 3 and 4 **B** 2, 3, 4 and 5 **C** 1 and 5 **D** 2 and 4 only

---

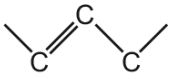
440. 9700_w16_qp_11 Q: 10

The diagrams show some of the types of bond in fatty acids.

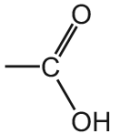
1



2



3



Which row shows the bonds found in each type of molecule?

	unsaturated fatty acid	saturated fatty acid
A	1, 2 and 3	1 and 3 only
B	1, 2 and 3	2 and 3 only
C	1 and 3 only	1, 2 and 3
D	2 and 3 only	1, 2 and 3

---

441. 9700_w16_qp_11 Q: 11

What could describe the tertiary structure of a protein?

1 α-helix

2 a globular structure

3 the specific order of amino acids

4 a specific three-dimensional (3D) shape

A 1, 2 and 3 **B** 1, 2 and 4 **C** 2 and 4 only **D** 3 and 4

---

442. 9700_w16_qp_12 Q: 10

The table shows some features of collagen and haemoglobin.

Which row is collagen?

	type of protein	number of polypeptides	solubility in water
A	fibrous	three	insoluble
B	fibrous	four	soluble
C	globular	three	insoluble
D	globular	four	soluble

---

443. 9700_w16_qp_12 Q: 12

What is the minimum number of carbon atoms in an amino acid?

A 1 **B** 2 **C** 3 **D** 4

---

444. 9700_w16_qp_12 Q: 13

HIV-1 protease is an enzyme produced by the HIV virus.

Two identical chains of 99 amino acids form the enzyme. In each chain, amino acids 25, 26 and 27 in the sequence form part of the active site.

Which orders of protein structure control the shape of the active site?

A primary, secondary, tertiary and quaternary

B primary, secondary and tertiary only

C primary and quaternary only

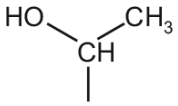
D quaternary only

---

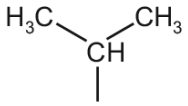
445. 9700_w16_qp_13 Q: 9

Threonylvaline is a dipeptide formed from the two amino acids, threonine and valine. A peptide bond forms between the carboxyl group of threonine and the amine group of valine.

The side-chains (R groups) of the two amino acids are shown.



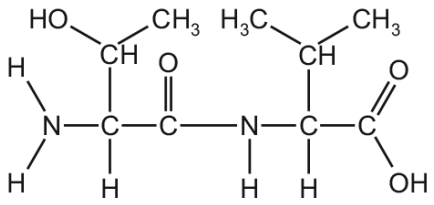
threonine



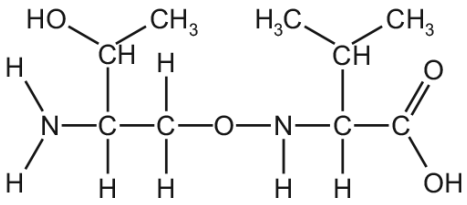
valine

Which molecular structure is threonylvaline?

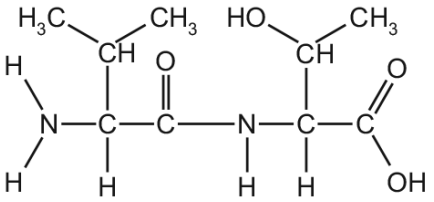
A



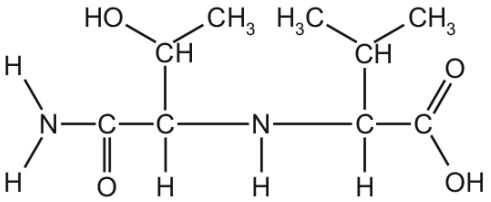
B



C



D



446. 9700_w16_qp_13 Q: 10

Which feature explains why haemoglobin is soluble?

A All four polypeptide chains are linked together to form a spherical molecule.

B Each polypeptide chain folds due to interactions between hydrophobic R groups.

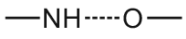
C The hydrophilic R groups are arranged around the outside of the molecule.

D The iron-containing haem group of each polypeptide chain is water soluble.

447. 9700_s15_qp_11 Q: 8

The diagrams show different types of bond found in biological molecules.

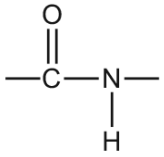
1



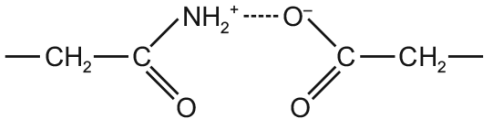
2



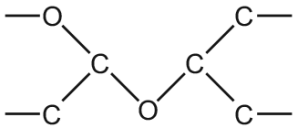
3



4



5



Which combination of bonds could **not** be found in a protein with a tertiary structure?

A 1, 2, 3 and 4 **B** 1, 2 and 4 only **C** 3 and 5 **D** 5 only

---

448. 9700_s15_qp_11 Q: 11

Which description is correct?

A A collagen molecule has a high proportion of the amino acid glycine, which has a very small side chain.

B A group of three collagen fibres forms a strong, insoluble coiled structure termed a triple helix.

C Each of the collagen polypeptides in a collagen molecule has a regular spiral arrangement of many alpha helices.

D Peptide bonds are present between amino acids of the same polypeptide and between the different polypeptides forming the collagen molecule.

---

449. 9700_s15_qp_11 Q: 12

Polar molecules form hydrogen bonds with each other.

Which properties of water result from its molecules being polar?

1 good solvent
2 high specific heat capacity
3 high surface tension
4 cohesive

A 1, 2, 3 and 4
B 1, 2 and 3 only
C 1, 2 and 4 only
D 3 and 4 only

---

450. 9700_s15_qp_12 Q: 7

Which type of bond holds together an α-helix or β-pleated sheet of a protein?

A disulfide
B hydrogen
C ionic
D peptide

---

451. 9700_s15_qp_12 Q: 8

What describes only the quaternary structure of haemoglobin?

1 α-helix
2 a dipeptide
3 a globular structure
4 the specific order of amino acids
5 four polypeptide chains joined together

A 1, 2 and 3 **B** 2, 4 and 5 **C** 1 and 4 **D** 5 only

---

452. 9700_s15_qp_12 Q: 9

The statements are about the properties of water.

1 ability to form hydrogen bonds with other molecules

2 less dense when frozen

3 able to hold a lot of heat

What allows a small insect to rest on the surface of a pond?

A 1 and 2 **B** 2 and 3 **C** 1 only **D** 2 only

---

453. 9700_s15_qp_12 Q: 12

Solutions of biological molecules are tested for sugars. The table shows the colours of the solutions after testing.

solution	heated with Benedict's solution	boiled with hydrochloric acid, neutralised, then heated with Benedict's solution
1	blue	orange
2	green	green
3	yellow	red

Which may contain non-reducing sugars?

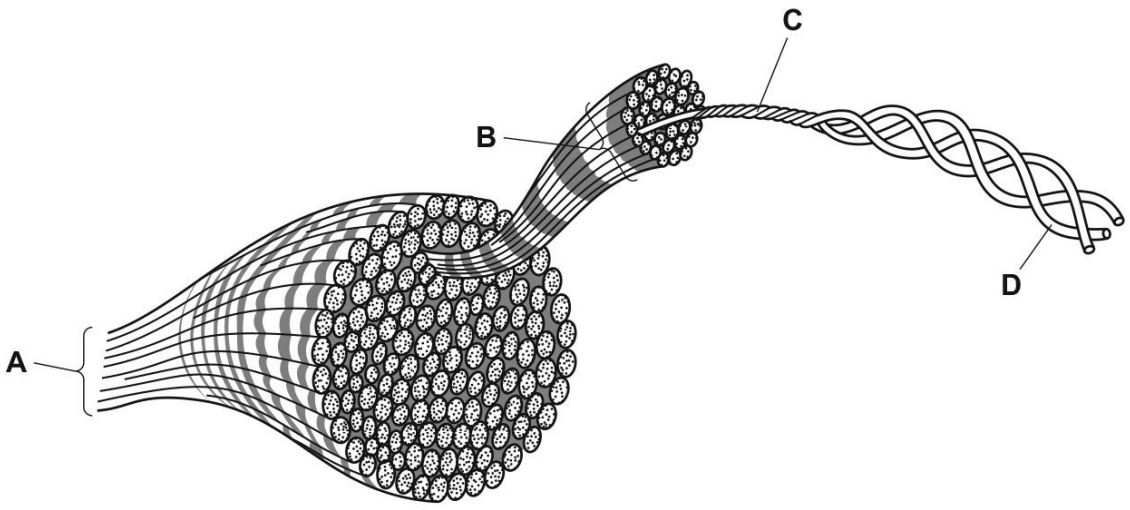
A 1, 2 and 3 **B** 1 and 2 only **C** 1 and 3 only **D** 2 and 3 only

---

454. 9700_s15_qp_13 Q: 8

The diagram shows the three dimensional structure of collagen.

Which labelled part represents a molecule of collagen?



---

455. 9700_s15_qp_13 Q: 9

Which type of bond does **not** hold together the tertiary structure of a protein?

A disulfide

B hydrogen

C hydrophobic interactions

D peptide

---

456. 9700_w15_qp_11 Q: 11

When a lake begins to freeze, which properties of water are needed for fish to survive?

1 Water has a high surface tension.

2 Water has a high latent heat of vaporisation.

3 Water has a high thermal capacity.

4 Water has its maximum density at 4 °C.

	1	2	3	4
A	✓	✓	✓	✗
B	✓	✗	✓	✗
C	✗	✓	✗	✓
D	✗	✗	✓	✓

key

✓ = needed

✗ = not needed

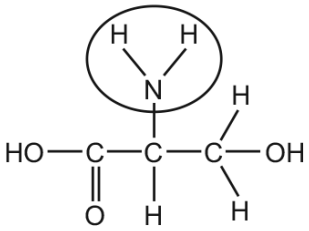
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457. 9700_w15_qp_12 Q: 10

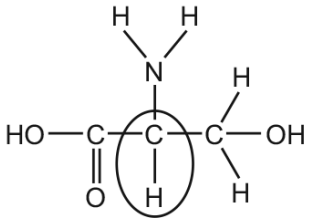
The diagrams show the amino acid serine.

Which circled area is different in all other amino acids?

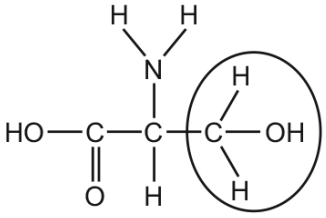
A



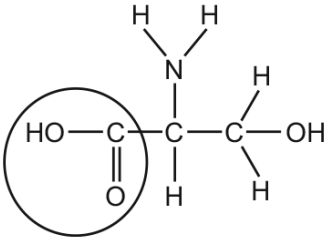
B



C



D



---

458. 9700_w15_qp_12 Q: 11

As a frozen lake warms after a cold winter, mineral nutrients are brought to the surface.

Which properties of water contribute to this process?

1 Its greatest density is at 4 °C.
2 It has high specific heat capacity.
3 It is a solvent.
4 Its molecules form hydrogen bonds.

A 1 and 3 **B** 1 and 4 **C** 2 and 3 **D** 2 and 4

---

459. 9700_w15_qp_13 Q: 10

High concentrations of urea break all bonds, except covalent bonds, in protein molecules.

Which level of protein structure would remain unchanged when a protein is treated with urea?

A primary

B secondary

C tertiary

D quaternary

---

460. 9700_w15_qp_13 Q: 11

Haemoglobin, a globular protein, consists of four polypeptide chains, two alpha chains and two beta chains. In normal individuals, in the DNA which codes for each beta chain, the sixth triplet has a code for glutamic acid.

In individuals with sickle cell anaemia this base triplet mutates and codes for valine.

What does this mutation change in the haemoglobin molecule?

A the iron content

B the primary structure

C the quaternary structure

D the secondary structure

Chapter 2

Biological molecules

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2.1 Carbohydrates and lipids

6. 9700_w15_qp_23 Q: 4

Glycogen is a highly branched polysaccharide molecule that is stored in the liver, kidney and muscles of mammals.

Fig. 4.1 shows a small part of a molecule of glycogen.

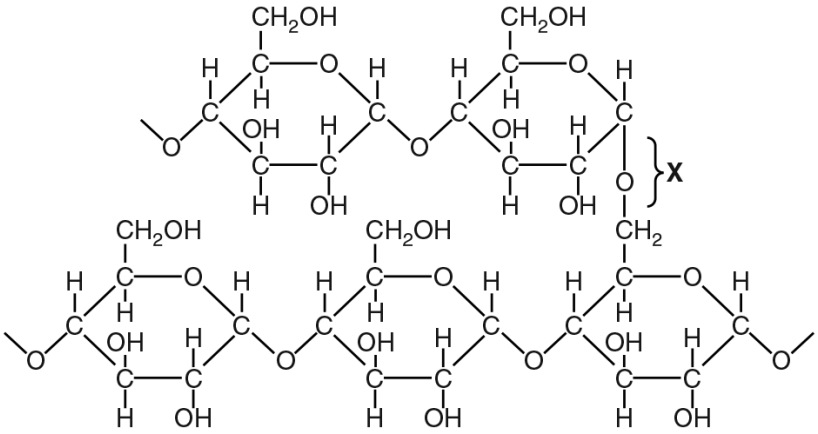


Fig. 4.1

(a) (i) Name the bond at **X**.

..... [1]

(ii) State the advantages for a mammal of having a storage molecule that is highly branched.

.....

.....

.....

.....

.....

.....

..... [2]

(iii) State two ways in which the structure of cellulose differs from the structure of glycogen.

1. .....

.....

2. .....

..... [2]

(b) Glycogen from animals and starch from plants form a large part of the energy intake of humans.

Fig. 4.2 is a flow chart that shows the energy input, in one growing season, into a field of a cereal crop which is processed to provide animal feed.

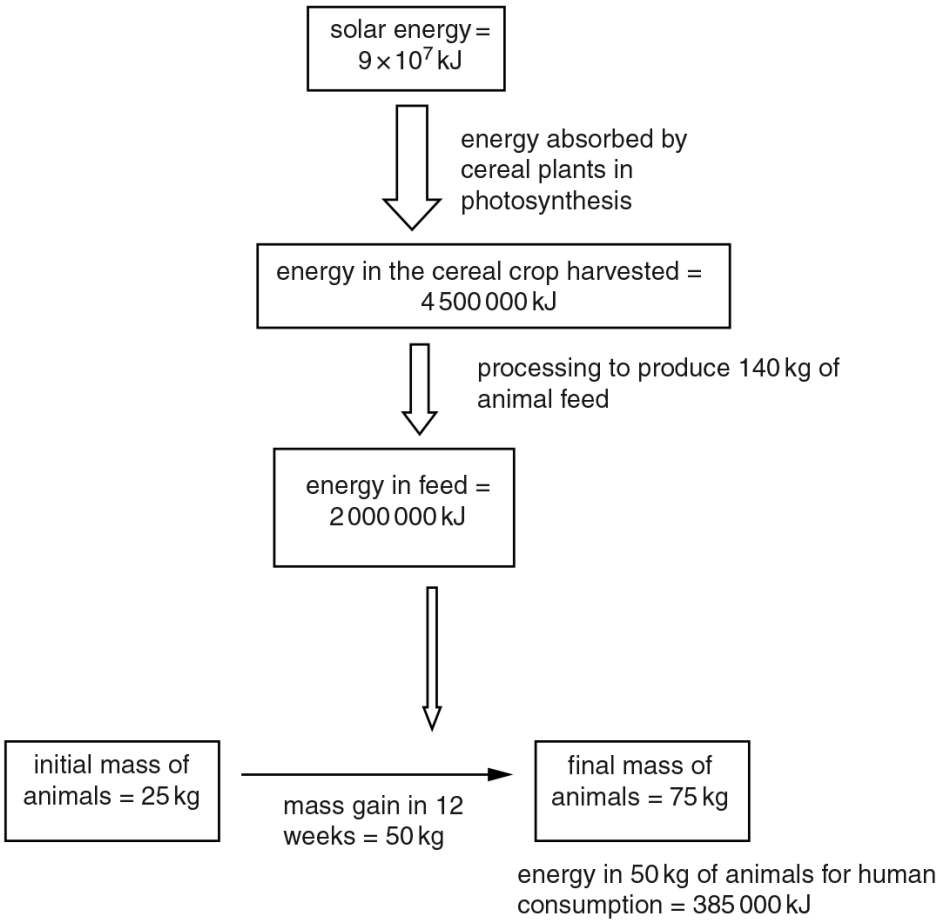


Fig. 4.2

(i) Calculate the percentage of the energy in animal feed that is converted into energy available for human consumption. Show your working.

answer ..... [2]

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(ii) Explain why the energy available to humans from feeding on animal products is much less than if the energy came directly from crop plants, such as cereals.

.....

.....

.....

.....

.....

.....

.....

.....

..... [3]

[Total: 10]

2.2 Proteins and water

7. 9700_s19_qp_22 Q: 5

Cells contain carbohydrates, proteins, lipids and nucleic acids.

(a) Fig. 5.1 is a list of biological molecules, some of which are components of larger molecules.

cellulose
thymine nucleotide
α-glucose
β-glucose
messenger RNA
glycogen
glycine
α-globin

Fig. 5.1

Complete Table 5.1 by using **only** the molecules listed in Fig. 5.1.

- Each example can be written under **one or more** correct headings.
- **All** the examples in Fig. 5.1 should appear at least **once** in Table 5.1.

Table 5.1

examples			
monomers	polymers	monosaccharides	polysaccharides

[5]

(b) Explain how the structure of phospholipids allows the formation of the phospholipid bilayer of cell membranes.

.....

.....

.....

.....

.....

.....

.....

..... [3]

[Total: 8]

---

8. 9700_w18_qp_21 Q: 3

(a) Fig. 3.1 is a transmission electron micrograph showing two adjacent cells in a leaf.

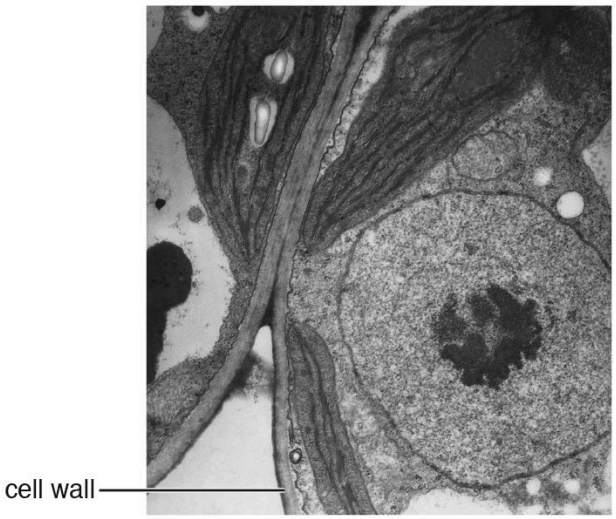


Fig. 3.1

(i) Cellulose is the main polysaccharide in cell walls of plants.

Describe the structure of cellulose.

.....

.....

.....

.....

.....

.....

.....

..... [3]

(ii) State **one** feature **visible** in Fig. 3.1, other than the cell wall, that identifies the cells as plant cells.

..... [1]

(iii) Outline the role of ATP in a leaf cell.

.....

.....

.....

.....

.....

.....

..... [3]

Water is a main component of plant cells.

(b) Fig. 3.2 shows two water molecules linked by a hydrogen bond.

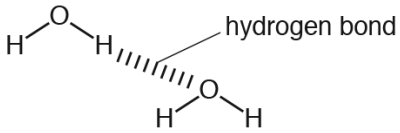


Fig. 3.2

Explain how hydrogen bonding occurs between water molecules.

.....

.....

.....

.....

.....

..... [2]

(c) Suggest why water is an excellent solvent for ions.

.....

.....

.....

.....

..... [2]

[Total: 11]

9. 9700_w18_qp_23 Q: 1

(a) Aphids are small insects which feed directly on phloem sap.

The salivary glands of aphids have secretory cells that make and release a variety of proteins that assist in feeding.

Fig. 1.1 is a transmission electron micrograph of a small area of a salivary gland cell of an aphid.

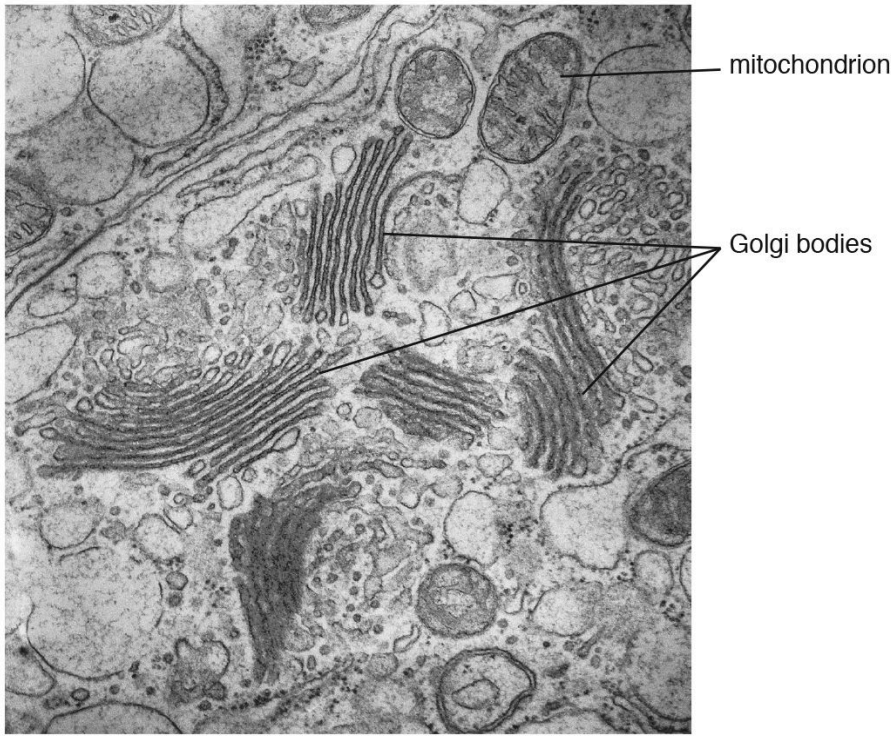


Fig. 1.1

Describe the role of Golgi bodies in secretory cells, such as the salivary gland cells of aphids.

.....

.....

.....

.....

.....

.....

.....

.....

..... [3]

(b) **(i)** Explain why secretory cells have large numbers of mitochondria.

.....

.....

.....

..... [2]

(ii) Mitochondria are partly controlled by the nucleus, but can also function independently.

Suggest the features of mitochondria that allow them to function independently of the nucleus.

.....

.....

.....

.....

.....

..... [2]

(c) Aphids are important vectors of plant viral diseases.

(i) Describe the structure of a typical virus.

.....

.....

.....

.....

.....

..... [3]

(ii) Suggest how viruses are able to pass from one plant cell to the next without crossing membranes.

.....

.....

..... [1]

[Total: 11]

10. 9700_w18_qp_23 Q: 2

(a) Proteins are macromolecules composed of many amino acids.

(i) Two amino acids are represented in the diagram in Fig. 2.1.

Complete the diagram to show how the two amino acids react together to form a dipeptide.

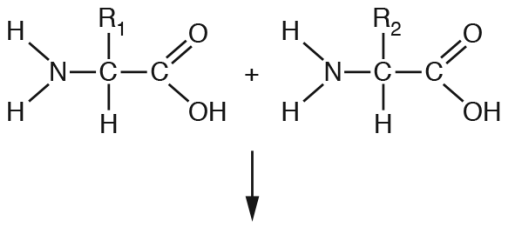


Fig. 2.1

[3]

(ii) State what is represented by R_1 and R_2 in Fig. 2.1.

.....

.....

.....

..... [2]

(b) Amylose and cellulose are polysaccharides.

Fig. 2.2 shows the structure of part of a cellulose molecule.

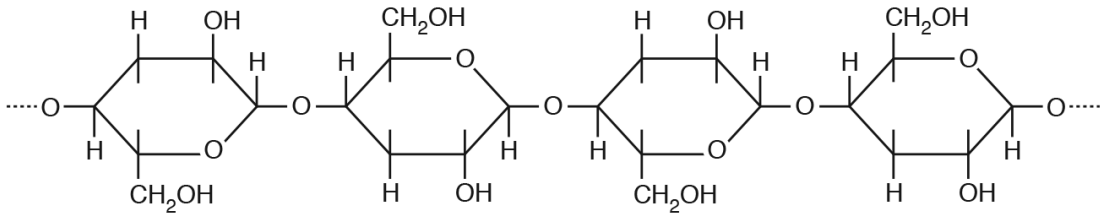


Fig. 2.2

With reference to Fig. 2.2, state how the **structure** of a cellulose molecule differs from the **structure** of an amylose molecule.

.....

.....

.....

.....

.....

..... [2]

(c) Cellulose is the main component of plant cell walls.

Explain why cellulose is suitable as a component of plant cell walls.

.....

.....

.....

.....

.....

.....

.....

.....

..... [4]

[Total: 11]

11. 9700_M16_qp_22 Q: 1

Statements **A** to **E** relate to biological molecules.

For each statement, identify the most appropriate term that matches the description.

A The molecule formed from a condensation reaction between fructose and glucose.

.....

B The name of the bond broken when two amino acids are separated by hydrolysis.

.....

C The unbranched polymer consisting only of β-glucose molecules.

.....

D The reagent used to test for the presence of proteins.

.....

E The molecule produced, in addition to fatty acids, when a triglyceride is hydrolysed.

.....

[5]

[Total: 5]

---

12. 9700_s16_qp_22 Q: 6

One of the enzymes involved in glycogen synthesis is glycogen synthase. The monomer of the glycogen polymer is α-glucose.

(a) (i) Draw the ring form of α-glucose in the space provided.

[2]

(ii) Glycogen synthase catalyses the formation of a covalent bond between two α-glucose molecules during glycogen synthesis.

Name the type of bond formed.

.....[1]

(iii) Glycogen branching enzyme is another enzyme that is required for glycogen synthesis.

Suggest why glycogen branching enzyme is needed in addition to glycogen synthase.

.....

.....

.....

.....[1]

(b) The gene coding for glycogen synthase in muscle cells is known as *GYS1*.

(i) Explain what is meant by a *gene*.

.....

.....

.....

.....

.....[2]

(ii) There are a number of known mutations for *GYS1*.

Outline how a mutation in *GYS1* can lead to the formation of an altered polypeptide where one amino acid is replaced by a different amino acid.

.....

.....

.....

.....

.....

.....

.....

.....[3]

(c) Table 6.1 shows three functions of cell structures that are involved in the synthesis of glycogen synthase.

Complete Table 6.1 by naming the cell structure that carries out the function listed.

Table 6.1

function	name of cell structure
assembles ribosomes for polypeptide synthesis	
synthesises ATP to provide a supply of energy for transcription of *GYS1*	
folds and modifies synthesised polypeptide to produce functioning glycogen synthase	

[3]

[Total: 12]

Q.1.

5 Haemoglobin is a globular protein with quaternary structure.

Fig. 5.1 is a diagram of the haemoglobin molecule.

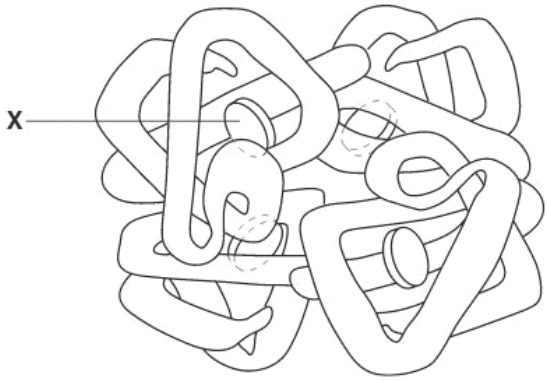


Fig. 5.1

(a) With reference to Fig. 5.1,

(i) name **X** and state its function;

.....

.....[2]

(ii) explain why haemoglobin is described as a *globular protein* with *quaternary structure*.

.....

.....

.....[2]

(b) Explain why people who have a deficiency of iron in their diet are often lacking in energy and feel tired.

.....

.....

.....

.....[3]

Q.2

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3 **(a)** The table below includes statements about the roles of water
- in living organisms
- as an environment for living organisms.

Complete the table by indicating with a tick (✓) which **one** of the properties of water is responsible for each role.

You should put only **one** tick in each row.

roles of water	properties of water			
	high specific heat capacity	strong cohesive forces between water molecules	high heat of vaporization	solvent for polar molecules and ions
transport medium in blood plasma and phloem				
surface for small insects to walk on				
major component of sweat used in heat loss				
transpiration pull in xylem				
preventing wide variations in body temperature				

[5]

Q.3

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(d) Starch grains in plant cells contain both amylose and amylopectin.

Explain how **both** of these substances are formed from glucose in plant cells.

.....

.....

.....

.....

.....

.....

.....

.....[4]

(e) State three functions of the water stored in the vacuoles of plant cells.

1. .....

2. .....

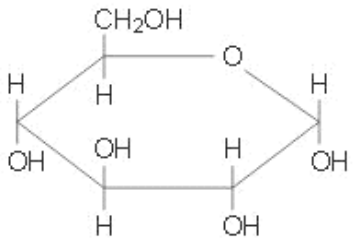
3. .....[3]

Q.4

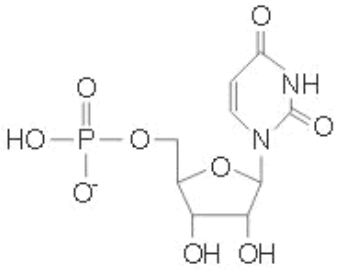
STEMUP.CO.UK

3 Fig. 3.1 shows seven biological molecules, labelled **D** to **K**.

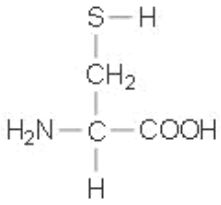
D



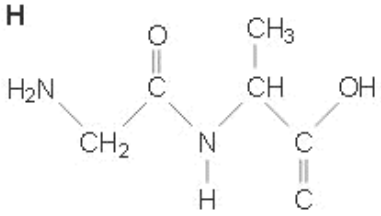
G



E



H



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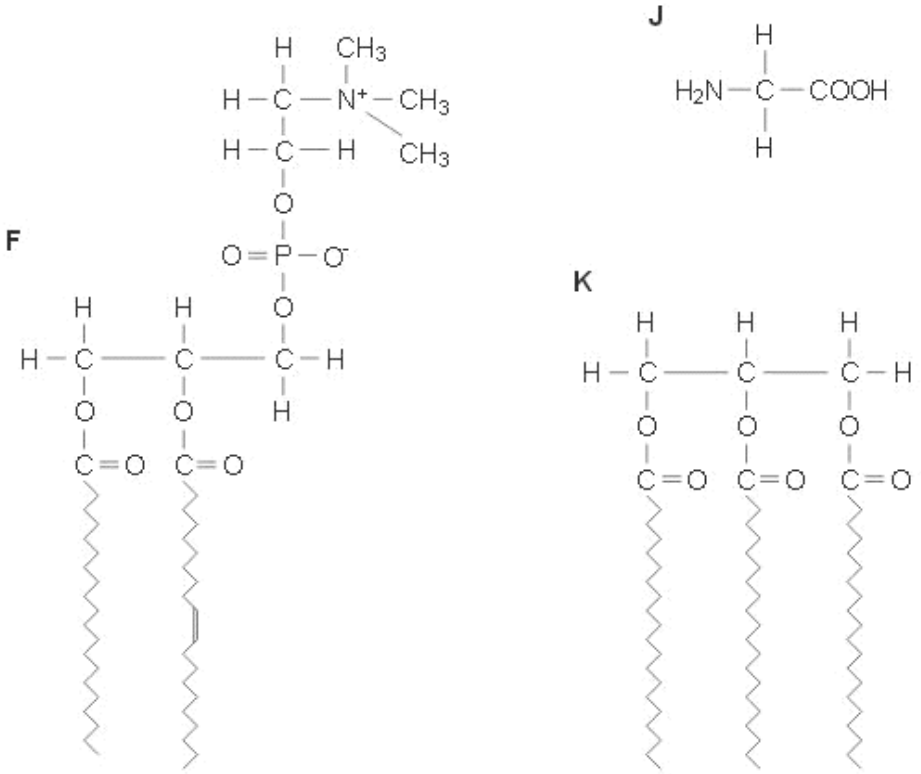


Fig. 3.1

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(a) Table 3.1 contains statements about the biological molecules in Fig. 3.1.

Complete the table by selecting the biological molecule from Fig. 3.1 that matches each of the statements. Write the appropriate letter from Fig. 3.1 in the table. The first one has been done for you.

You may use each letter once, more than once or not at all.

Table 3.1

statement	letter
an amino acid that is a major constituent of collagen	**J**
a component of RNA	
a molecule that is polymerised to form glycogen	
a molecule with a peptide bond	
an important store of energy, insoluble in water	
a molecule with hydrophilic and hydrophobic regions	
an amino acid that forms disulfide (disulphide) bonds in proteins	

[6]

(b) Describe two ways in which the **structure** of DNA differs from the **structure** of collagen.

1 .....

.....

2 .....

..... [2]

[Total: 8]

Q.5

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1 **(a)** Fig. 1.1 shows the breakdown of a molecule of sucrose.

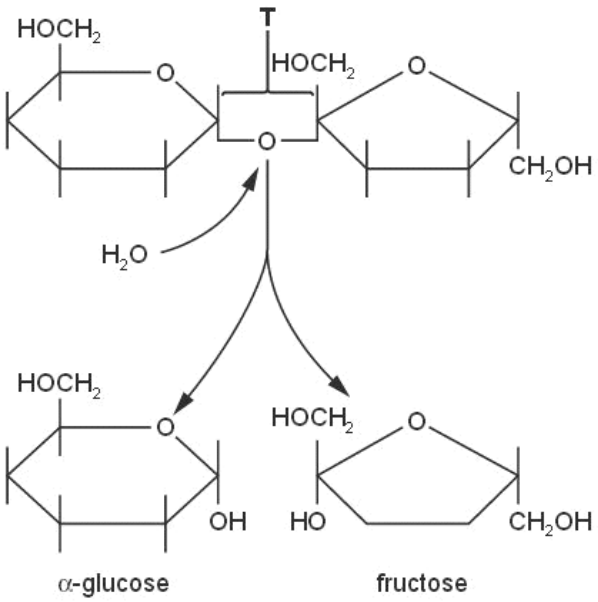


Fig. 1.1

(i) Name the bond indicated by **T**.

.....[1]

(ii) State the name given to this type of reaction in which water is involved.

.....[1]

(iii) State two roles of water **within plant cells** other than taking part in breakdown reactions.

1. .....

2. .....[2]

(b) Enzymes are globular proteins.

State what is meant by the term *globular*.

.....

.....

.....

.....[2]

Q.6

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4 Fig. 4.1 shows the primary structure of a lysozyme molecule, an enzyme found in tears, saliva and in lysosomes.

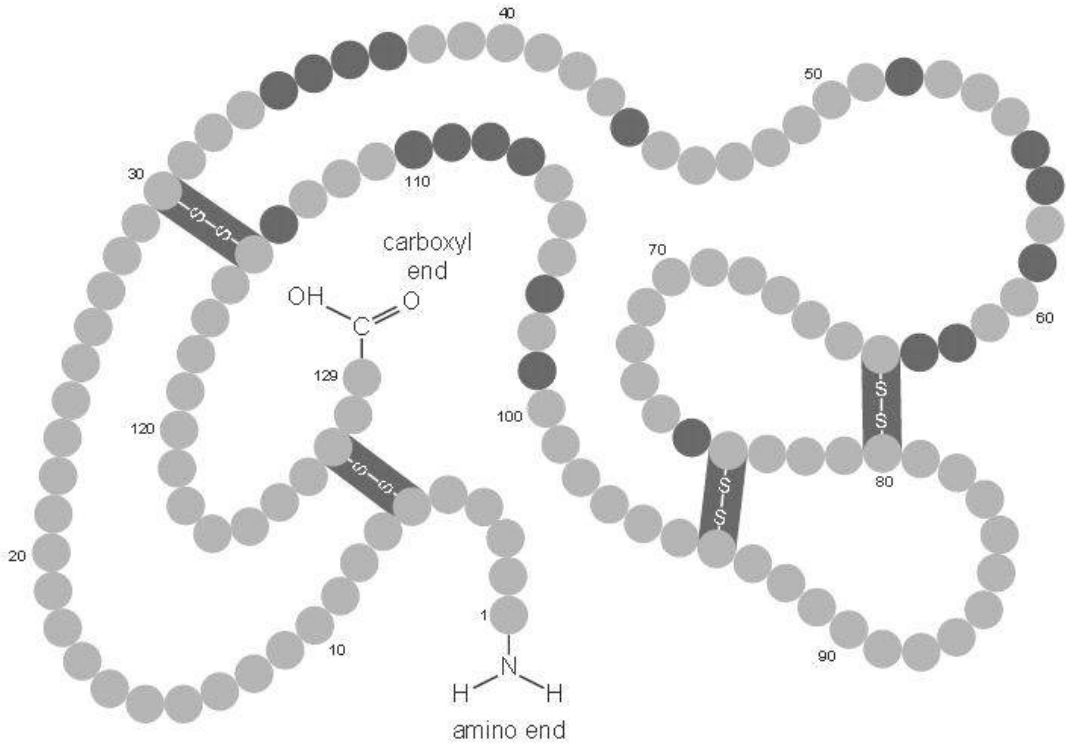


Fig. 4.1

(a) (i) Explain what is meant by the term *primary structure*.

.....

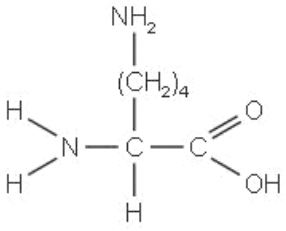
.....

.....[1]

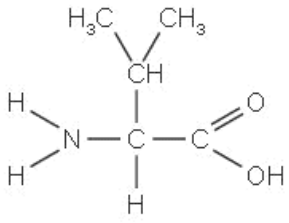
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(ii) The molecular structure of the first two amino acids of lysozyme, lysine and valine, is shown below.

Use the space to show how these amino acids become linked in a condensation reaction.



lysine



valine

[3]

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(b) Proteins, such as the enzyme lysozyme, have a secondary structure and a tertiary structure.

(i) Describe the secondary and tertiary structure of an enzymatic protein, such as lysozyme.

secondary .....

.....

.....

.....

tertiary .....

.....

.....

.....

.....

.....

.....[5]

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(ii) State why it is important for enzymes, such as lysozyme, to possess a tertiary structure.

.....

.....[1]

(c) Some people have a rare disease caused by a single change in the DNA nucleotide sequence of the gene coding for lysozyme. The change leads to the formation of an insoluble protein that has a different structure to the normal soluble lysozyme molecule.

Suggest how a change in the gene can lead to the differences observed between the normal lysozyme and the changed lysozyme.

.....

.....

.....

.....

.....

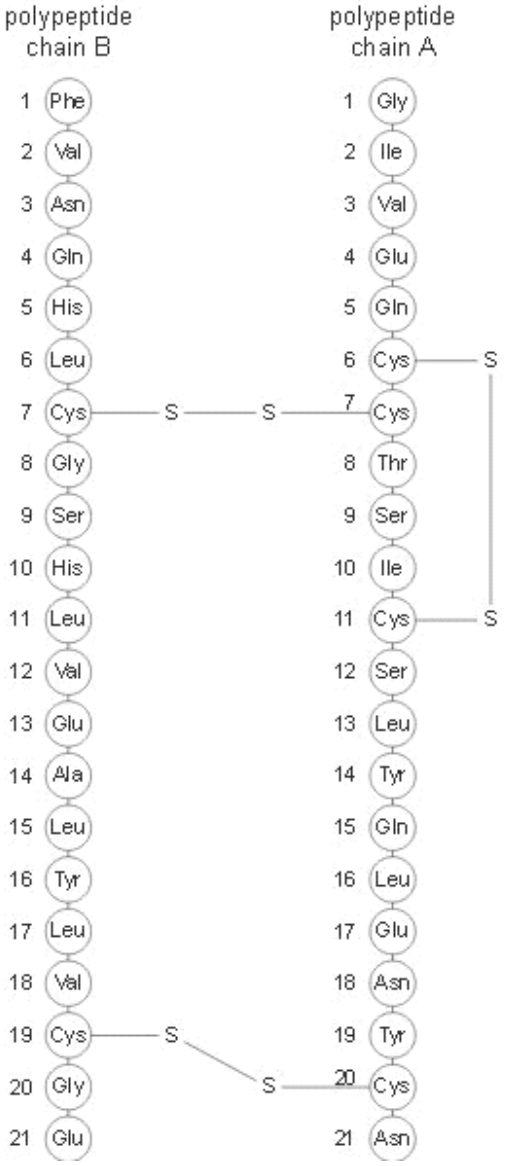
.....[3]

[Total: 13]

Q.7.

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3 The amino acid sequence of the protein hormone insulin is shown in Fig. 3.1.



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Fig. 3.1

(a) With reference to Fig. 3.1, state

(i) which two levels of protein structure are shown

1. .....

2. .....[2]

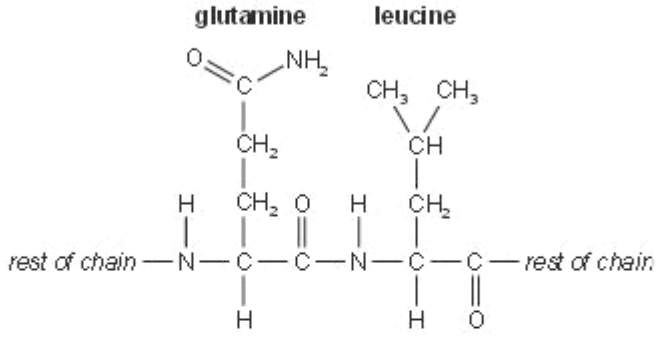
(ii) the name of the structures responsible for holding the two polypeptide chains together.

.....[1]

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(b) Many people with diabetes need to take regular injections of insulin. Insulin in the form shown in Fig. 3.1 cannot be taken by mouth as it would be hydrolysed by proteases in the gut.

In the space below, draw a diagram to show how the peptide bond between glutamine 15 and leucine 16 in polypeptide chain A could be hydrolysed and show the products of the hydrolysis.



[3]

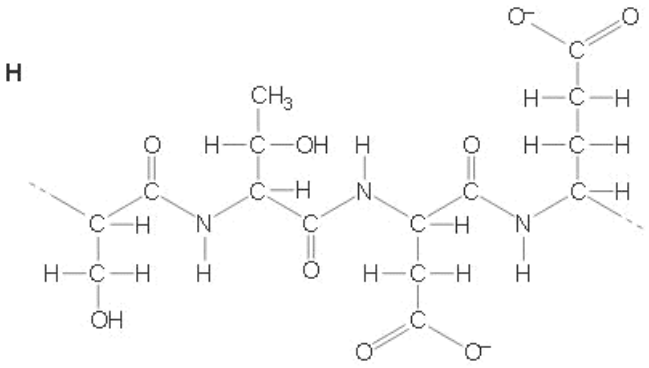
[Total: 6]

Q.8.

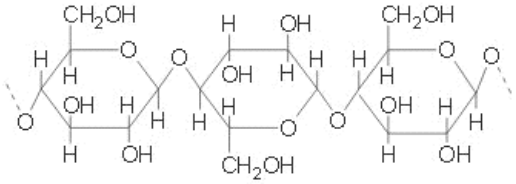
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5 Fig. 5.1 shows five different biological molecules.

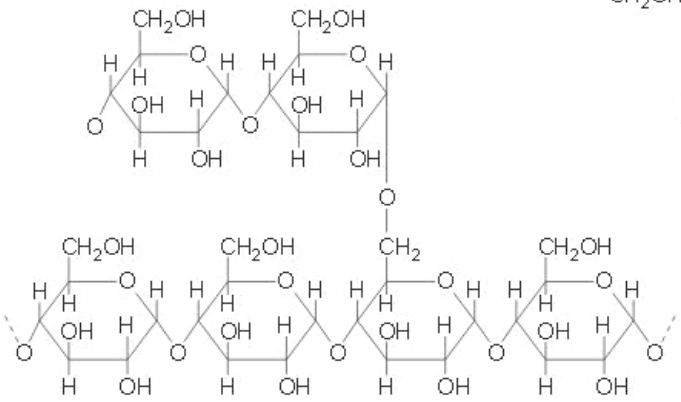
H



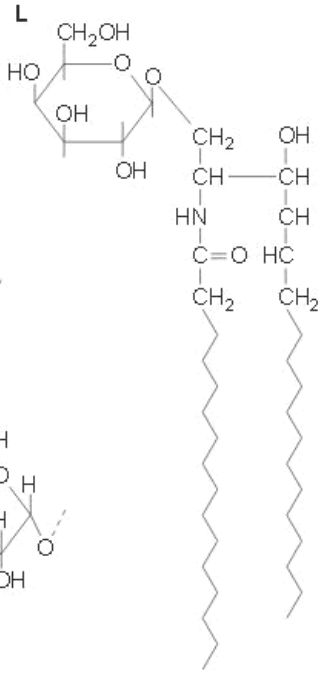
J



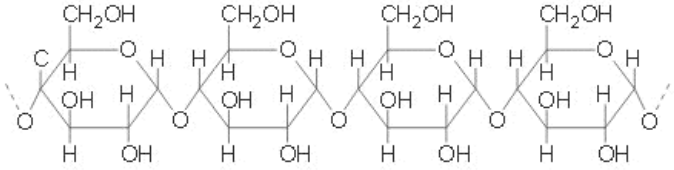
K



L



M



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Complete Table 5.1 by indicating which molecule matches each statement.

You may use each letter (**H** to **M**) once, more than once or not at all.

You should write only one letter in each box.

Table 5.1

statement	letter
contains peptide bonds	
part of the molecule forms the hydrophobic part of cell membranes	
contains 1-4 and 1-6 glycosidic bonds	
forms the primary structure of a protein	
used for energy storage in plants	
forms a helical structure	
the sub-unit molecule is β-glucose	

[Total: 7]

Q.9.

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5 **(a)** Fig. 5.1 represents a molecule of a triglyceride.

Name the components **A** and **C** and name the bond **B**.

Write your answers on the dotted lines provided in Fig. 5.1.

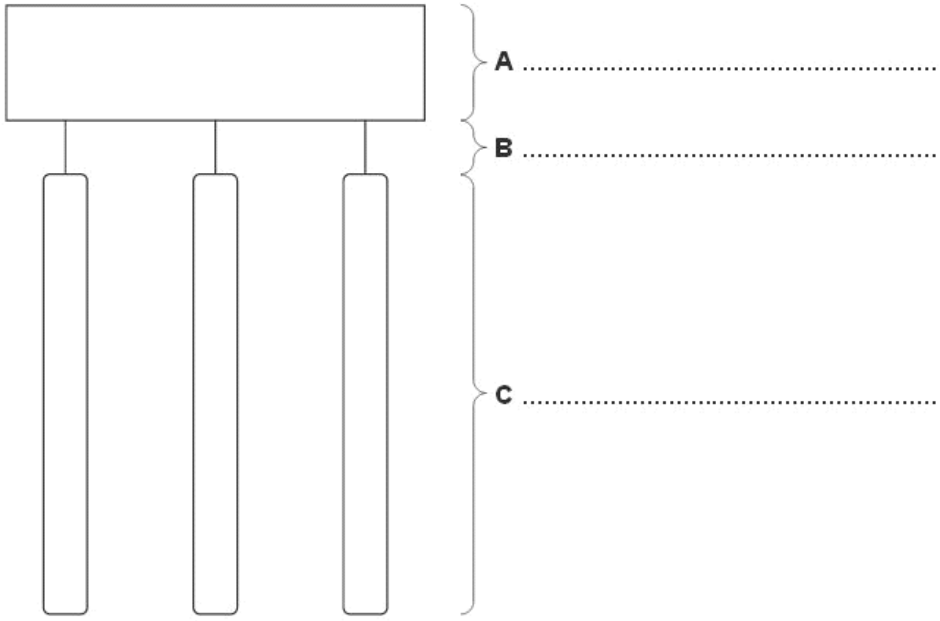


Fig. 5.1 [3]

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(b) A phospholipid is sometimes described as a modified triglyceride.

(i) State how the structure of a phospholipid differs from a triglyceride.

.....

.....

.....[2]

(ii) Explain how a phospholipid is suited to its role in cell membranes.

.....

.....

.....

.....

.....

.....[3]

Q.10.

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4 Penicillin is an antibiotic that interferes with the synthesis of cell walls in bacteria. Even before penicillin became widely available in the 1940s, the enzyme penicillinase which breaks down penicillin had been isolated. This enzyme is now found in many bacteria and gives them resistance to penicillin.

Fig. 4.1 is a ribbon model of the structure of the enzyme penicillinase. The arrow indicates the active site of the enzyme.



(b) With reference to Fig. 4.1, identify the aspects of protein structure that are shown and those that are **not** shown.

aspects of protein structure shown

.....

.....

.....

.....

aspects of protein structure not shown

.....

.....

.....

.....[3]

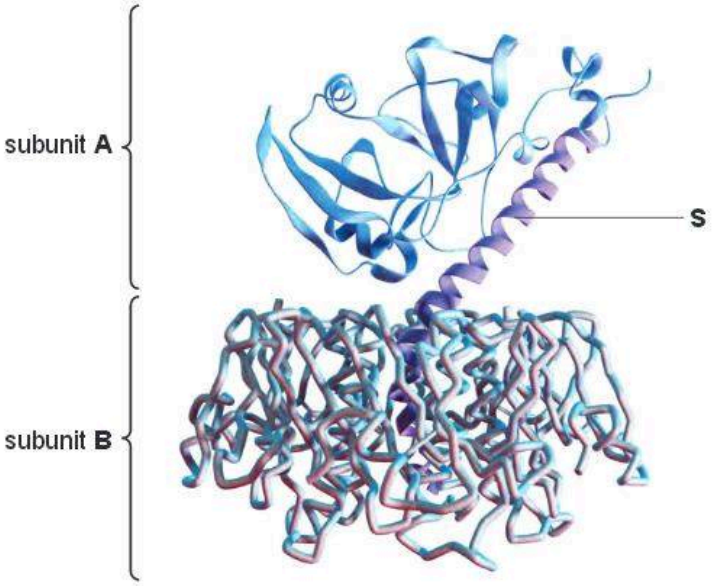
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Q.11.

3 Cholera is a disease caused by the bacterium *Vibrio cholerae*. The disease symptoms are caused by a toxin, produced by the bacterium, interacting with proteins in the cell surface membranes of epithelial cells in the human intestine.

The cholera toxin is a protein and is composed of two subunits, **A** and **B**. Subunit **A** is made from one polypeptide and subunit **B** is made from five identical polypeptides.

Fig. 3.1 shows the structure of the cholera toxin.



(a) Name:

(i) the level of structure that is only shown by a protein that has more than one polypeptide chain

.....[1]

(ii) the part labelled **S**.

.....[1]

Q.12

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4 Polysaccharides are synthesised by condensation reactions between monosaccharide or disaccharide subunits (monomers).

(a) Name the type of bond formed when polysaccharides are synthesised.

..... [1]

(b) Disaccharides are formed following synthesis from monosaccharides or as a result of polysaccharide hydrolysis.

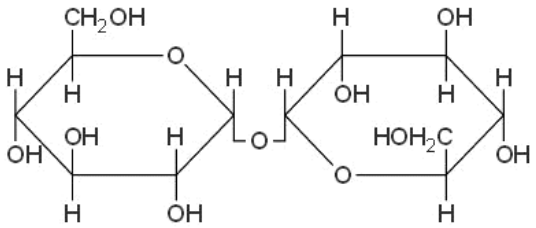
Cellobiose, maltose, sucrose and trehalose are four different disaccharides found in nature. Fig. 4.1 shows the molecular structure of these disaccharides.

Identify the disaccharides, labelled **A** to **D**, using the information below.

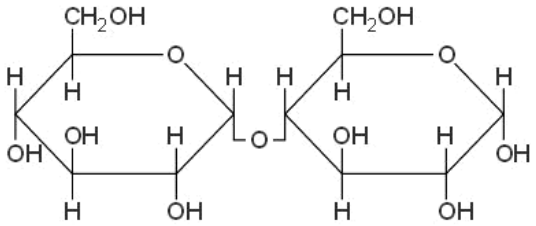
- The disaccharide cellobiose is formed from the hydrolysis of the polysaccharide cellulose.
- When cellobiose is hydrolysed, two **β-glucose** molecules are produced.
- One of the disaccharides is sucrose.
- Trehalose is a disaccharide that is synthesised from two **α-glucose** molecules.
- The disaccharide maltose is formed from the hydrolysis of amylose, a component of starch.

Write the name of the disaccharides in the spaces provided on Fig. 4.1.

9

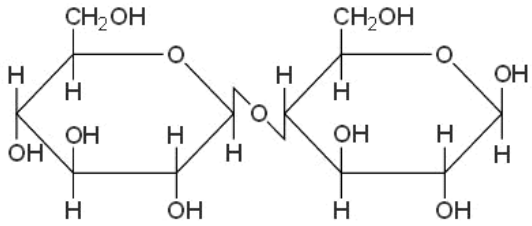


A .....

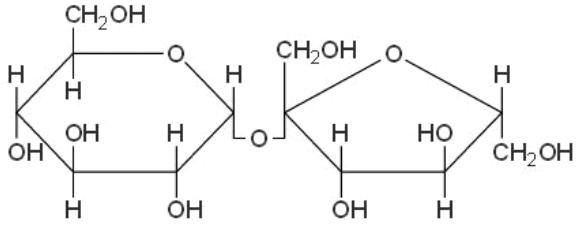


B .....

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C .....



D .....

[3]

Fig. 4.1

Q.13.

2 Fig. 2.1 shows the reaction to form triglycerides.

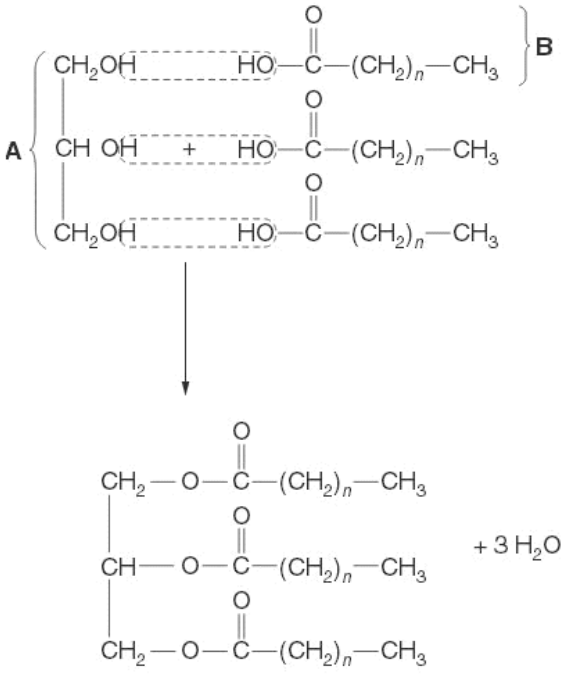


Fig. 2.1

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(a) With reference to Fig. 2.1,

(i) name the molecules **A** and **B**;

A .....

B .....[2]

(ii) state the name of the reaction shown.

.....[1]

(b) Animals and plants store triglycerides as energy reserves.

Explain the advantages of storing triglycerides as energy reserves rather than carbohydrates, such as starch.

.....

.....

.....[2]

Overconsumption of fat in the diet may lead to obesity.

(c) State how it is determined whether a person is sufficiently overweight to be classed as obese.

.....

.....

.....[1]

(d) Outline two risks to health of being obese.

1. .....

2. .....[2]

[Total : 8]

Q.14

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4 Starch, glycogen and cellulose are all polysaccharides. They are made from monomers that are joined by covalent bonds.

(a) Complete the table below to show which of the statements apply to each of the polysaccharides.

Fill in each box using a tick (✓) to show that the statement applies and a cross (✗) if it does not.

statement	starch	glycogen	cellulose
glycosidic bonds between monomers			
monomer is β glucose			
stored within chloroplasts			
stored in muscle cells			
exists in two forms – branched and unbranched chains			

[5]

A solution of the enzyme amylase was added to a solution of starch and kept at 25 °C. The starch was broken down by hydrolysis.

(b) Explain how you would determine the rate of hydrolysis.

.....

.....

.....

.....

.....

.....[4]

[Total: 9]

Q.15.

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2 Fig. 2.1 shows a β glucose molecule.

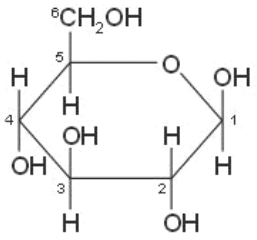


Fig. 2.1

(a) State how α **glucose** differs from β glucose as shown in Fig. 2.1.

.....[1]

(b) Fig. 2.2 shows a molecule of β glucose that is about to be added to the end of a growing chain of a polysaccharide.

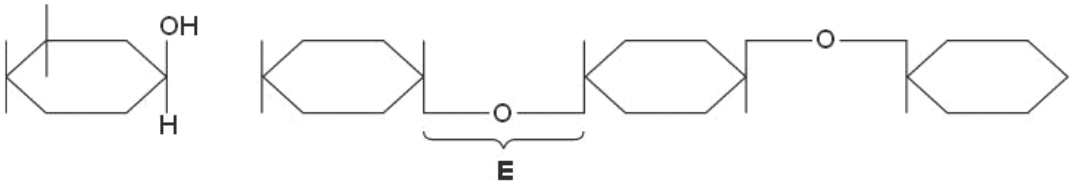


Fig. 2.2

(i) Name the bond **E**.

.....[1]

(ii) Use the diagram below to show how the β glucose molecule will attach to the end of the growing chain of the polysaccharide. You may annotate the diagram if you wish.



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(iii) Name a polysaccharide that is formed entirely from β glucose molecules in the way shown in Fig. 2.2.

.....[1]

(c) A solution of starch was poured into six separate test-tubes, labelled **F** to **K**. The test-tubes were kept at 35 °C for 5 minutes and then treated as shown in Table 2.1. After a further 30 minutes the contents of the test-tubes were tested for the presence of reducing sugar.

Table 2.1

test-tubes	substances added after 5 minutes	presence or absence of reducing sugar after 30 minutes
F	distilled water	absent
G	amylase + boiled maltase	present
H	amylase + distilled water	present
I	boiled amylase + maltase	absent
J	amylase + maltase	present
K	maltase + distilled water	absent

Explain the results shown in Table 2.1.

.....

.....

.....

.....

.....

.....

.....

.....[4]

[Total : 10]

Q.16

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2 Phospholipids are components of cell surface membranes.

(a) Describe how phospholipid molecules are arranged in a cell surface membrane.

You may use the space below for a **simple annotated** diagram if you wish.

.....

.....

.....

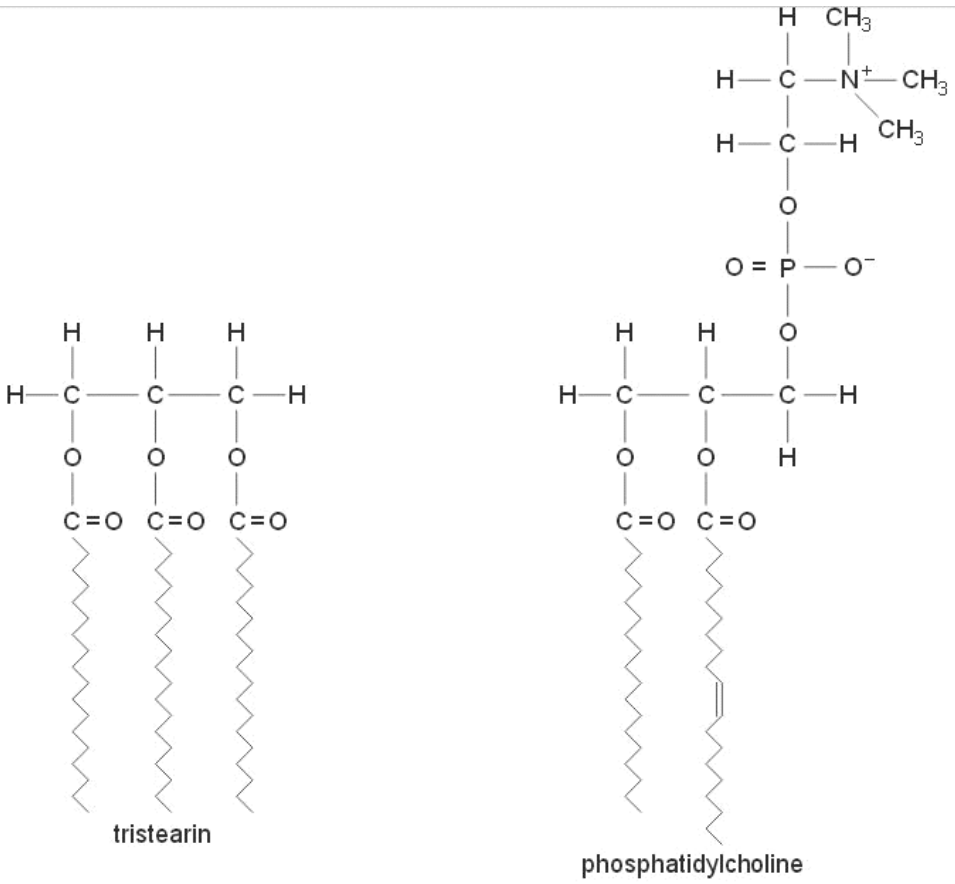
.....

[2]

Fig. 2.1 shows the structure of the lipids:

- tristearin, which is a triglyceride;
- phosphatidylcholine, which is a phospholipid.

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(b) State two ways, **visible in Fig. 2.1**, in which phosphatidylcholine differs from tristearin.

1. .....

.....

2. .....

.....[2]

(c) Explain how the structure of triglycerides, such as tristearin, makes them more suitable for energy storage than carbohydrates, such as glycogen.

.....

.....

.....

.....[2]

Q.17

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6 Haemoglobin is a globular protein that shows quaternary structure. It is composed of two types of polypeptide, known as α and β globin.

(a) Explain how a globular protein differs from a fibrous protein, such as collagen.

.....

.....

.....

.....[2]

Fig. 6.1 shows part of the base sequence of the mRNA that codes for the first ten amino acids of β globin. Table 6.1 shows some of the codons and the amino acids for which they code.

GUG	CAC	CUG	ACU	CCU	GAG	GAG	AAG	UCU	GCC

Fig. 6.1

Table 6.1

amino acid	abbreviation	codons					
alanine	ala	GCA	GCC	GCG	GCU		
glutamic acid	glu	GAA	GAG				
histidine	his	CAC	CAU				
leucine	leu	UUA	UUG	CUA	CUC	CUG	CUU
lysine	lys	AAA	AAG				
proline	pro	CCA	CCC	CCG	CCU		
serine	ser	UCA	UCC	UCG	UCU	AGC	AGU
threonine	thr	ACA	ACC	ACG	ACU		
valine	val	GUA	GUC	GUG	GUU		

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(b) Use the information in Table 6.1 to complete the sequence of amino acids at the beginning of β globin using the first three letters of each amino acid. Some of them have been done for you.

val	his				glu				ala

[2]

15

(c) β globin has a tertiary structure that consists of eight helices arranged to give a precise three-dimensional shape.

Describe how the precise three-dimensional shape of a polypeptide is maintained.

.....

.....

.....

.....

.....

.....

.....

.....[4]

[Total: 8]

Q.18

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2 Scientists have developed a variety of ways to represent the three dimensional structure of proteins. Fig. 2.1 shows one way of representing the structure of the protein, haemoglobin.

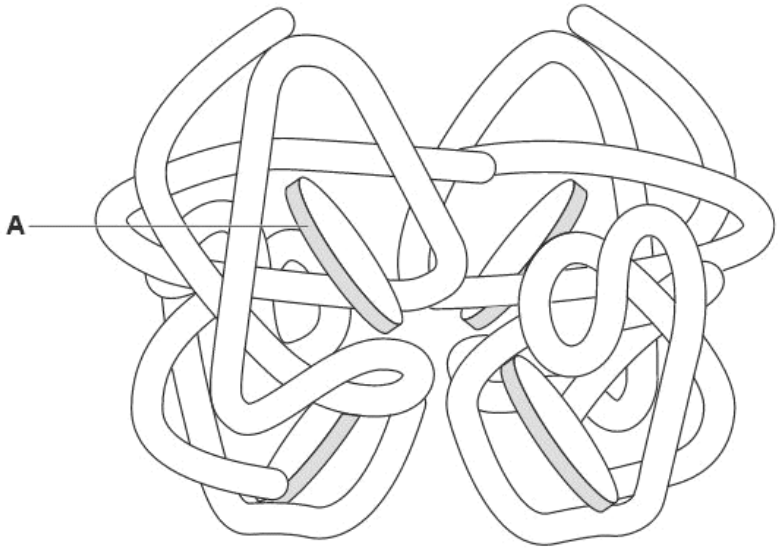


Fig. 2.1

(a) (i) Name **A** and state its role.

name .....

role .....

.....

.....[3]

(ii) With reference to Fig. 2.1, explain why a molecule of haemoglobin is said to show **both** tertiary structure and quaternary structure.

.....

.....

.....

.....

.....[2]

Q.19.

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5 **(a)** Table 5.1 contains statements about four molecules.

Complete the table by indicating with a tick (✓) or a cross (✘) whether the statements apply to haemoglobin, DNA, phospholipids or antibodies.

You should put a tick or a cross in each box of the table.

Table 5.1

statement	haemoglobin	DNA	phospholipids	antibodies
contains iron				
contains phosphate				
able to replicate				
hydrogen bonds stabilise the molecule				
contains nitrogen				

[5]

(b) Water is sometimes described as providing an ideal environment for many organisms.

Explain how the hydrogen bonds between water molecules affect the properties of water and help to make water an ideal environment for many organisms.

.....

.....

.....

.....

.....

.....

.....

.....

..... [5]

[Total: 10]

Q.20.

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2 Polysaccharides, such as glycogen, amylopectin and amylose, are formed by polymerisation of glucose. Fig. 2.1 shows part of a glycogen molecule.

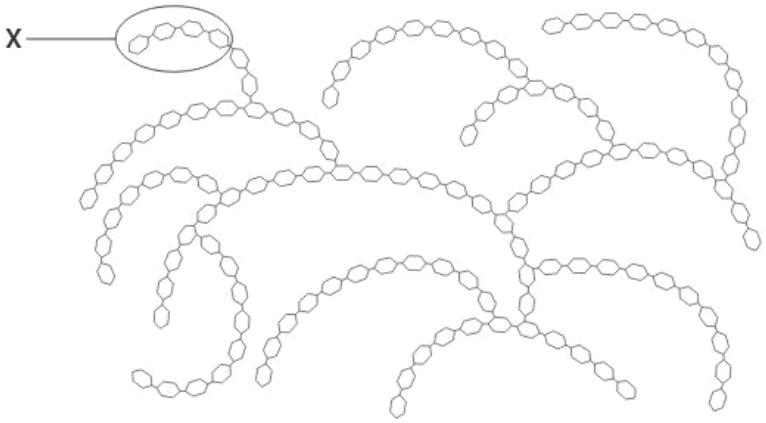


Fig. 2.1

(a) With reference to Fig. 2.1,

(i) describe how the **structure** of glycogen differs from the structure of amylose;

.....

.....

.....

.....

..... [2]

(ii) describe the advantages for organisms in storing polysaccharides, such as glycogen, rather than storing glucose.

.....

.....

.....

.....

.....

..... [3]

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(b) Glycogen may be broken down to form glucose.

Fig. 2.2 shows region **X** from the glycogen molecule in Fig. 2.1 in more detail.

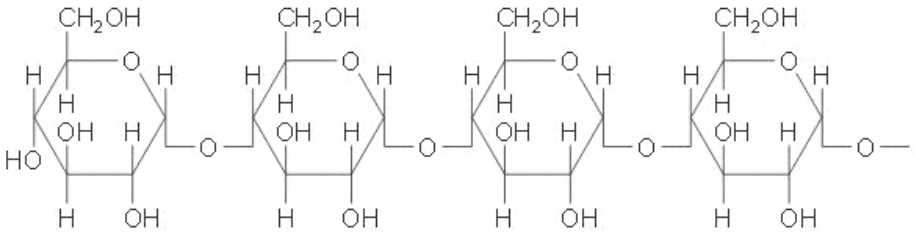


Fig. 2.2

Draw an annotated diagram in the space provided to explain how a glucose molecule is formed from the free end of the glycogen molecule shown in Fig. 2.2.

[3]

[Total: 8]

Q.21

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5 **(a)** Cellulose is a polysaccharide.

Fig. 5.1 shows three sub-units from a molecule of cellulose.

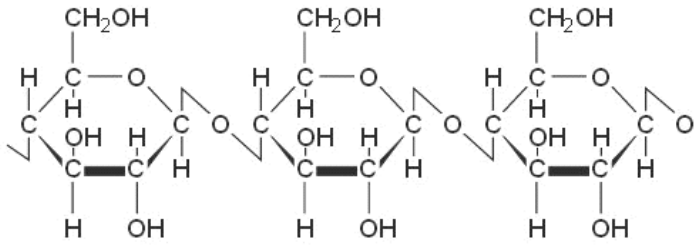


Fig. 5.1

(i) Name the sub-unit molecule of cellulose.

.....[1]

(ii) Name the bonds that attach the sub-unit molecules together within cellulose.

.....[1]

(b) Cellulose has high mechanical strength which makes it suitable for the cell walls of plants.

Explain how cellulose has such a high mechanical strength making it suitable for the cell walls of plants.

.....

.....

.....

.....[2]

Q.22.

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3 Fig. 3.1 shows a molecule of haemoglobin.



Fig. 3.1

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(a) Explain how a molecule of haemoglobin shows the four levels of organisation of protein molecules.

primary structure .....

.....

.....

secondary structure .....

.....

.....

tertiary structure .....

.....

.....

quaternary structure .....

.....

.....[4]

There are many different variants of haemoglobin. The sequence of bases in DNA that code for the first seven amino acids in two variants of the β-globin polypeptide are shown in Fig. 3.2.

The genetic dictionary for some of the amino acids is in Table 3.1.

Variant 1

1	2	3	4	5	6	7
CAC	GTG	GAC	TGA	GGA	CTC	CTC

Variant 2

1	2	3	4	5	6	7
CAC	GTG	GAC	TGA	GGA	CAC	CTC

Fig. 3.2

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Table 3.1

amino acid	abbreviation	DNA triplets on the coding polynucleotide
valine	val	CAA, CAC, CAG, CAT
proline	pro	GGA, GGC, GGG, GGT
threonine	thr	TGA, TGC, TGG, TGT
histidine	his	GTA, GTG
glutamic acid	glu	CTC, CTT
leucine	leu	AAC, AAT, GAA, GAC, GAG, GAT

(b) Use the genetic dictionary to describe the similarities and differences between the two variants of haemoglobin.

.....

.....

.....

.....

.....

.....[3]

(c) Collagen is a fibrous protein found in many tissues in animals.

(i) State the function of collagen in the walls of arteries.

.....

.....[1]

(ii) State **one** way in which the **structure** of collagen differs from the structure of haemoglobin.

.....

.....[1]

[Total: 9]

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Q.23.

4 **(a)** Fig. 4.1 shows the structure of deoxyribose sugar.

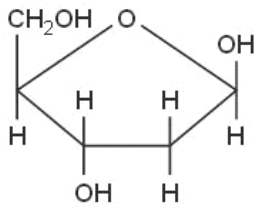


Fig. 4.1

State the differences between the structure of deoxyribose shown in Fig. 4.1 and the ring structure of α-glucose.

You may use the space below to help you in your answer.

.....

.....

.....

.....

[3]

(b) Match the biological macromolecule with the type of bond that is formed when the molecule is synthesised. Choose from the list below.

amylose cellulose triglyceride protein amylopectin mRNA

type of bond(s)	biological macromolecule
β, 1-4 glycosidic	
α, 1-4 glycosidic **and** α, 1-6 glycosidic	
phosphodiester	
peptide	

[4]

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Q.24.

(b) As shown in Fig. 1.1, liver cells contain many storage granules of glycogen.

Describe the molecular structure of glycogen **and** explain how this structure makes it suitable for storage.

.....

.....

.....

.....

.....

.....

.....

.....[4]

Q.25.

(d) In Fig. 1.1, starch granules are visible within the chloroplasts. Starch is the most common storage compound of plants. It is composed of amylopectin and amylose.

(i) Describe the structural differences between amylopectin and amylose.

.....

.....

.....

.....

..... [2]

(ii) State **one** role of magnesium ions within chloroplasts.

.....

..... [1]

Q.26

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2 **(a)** Table 2.1 shows eight ions that are biologically important.

Table 2.1

ammonium (NH_4^+)	**A**
hydrogen (H^+)	**B**
hydrogen carbonate (HCO_3^-)	**C**
iron (Fe^{2+})	**D**
magnesium (Mg^{2+})	**E**
nitrate (NO_3^-)	**F**
phosphate (PO_4^{3-})	**G**
sulfate (SO_4^{2-})	**H**

Choose one ion to match each of the following statements. In each case write **one** letter from Table 2.1. You may use each letter (**A** to **H**) once, more than once or not at all.

(i) A component of polynucleotides.

.....[1]

(ii) Ion produced by enzyme activity inside red blood cells.

.....[1]

(iii) Ion used in the production of all amino acids in chloroplasts.

.....[1]

(iv) Ion that diffuses through carrier proteins with sucrose into companion cells in phloem tissue.

.....[1]

(v) Component of haem group in haemoglobin that binds oxygen.

.....[1]

Q.27.

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2 Keratin and chitin are two important biological molecules. Keratin is found in hair, fur and skin. Chitin is a modified polysaccharide found in a number of different organisms, for example in fungal cell walls and the hard outer skeletons of insects.

(a) Features of chitin and keratin are shown in the boxes in Fig. 2.1.

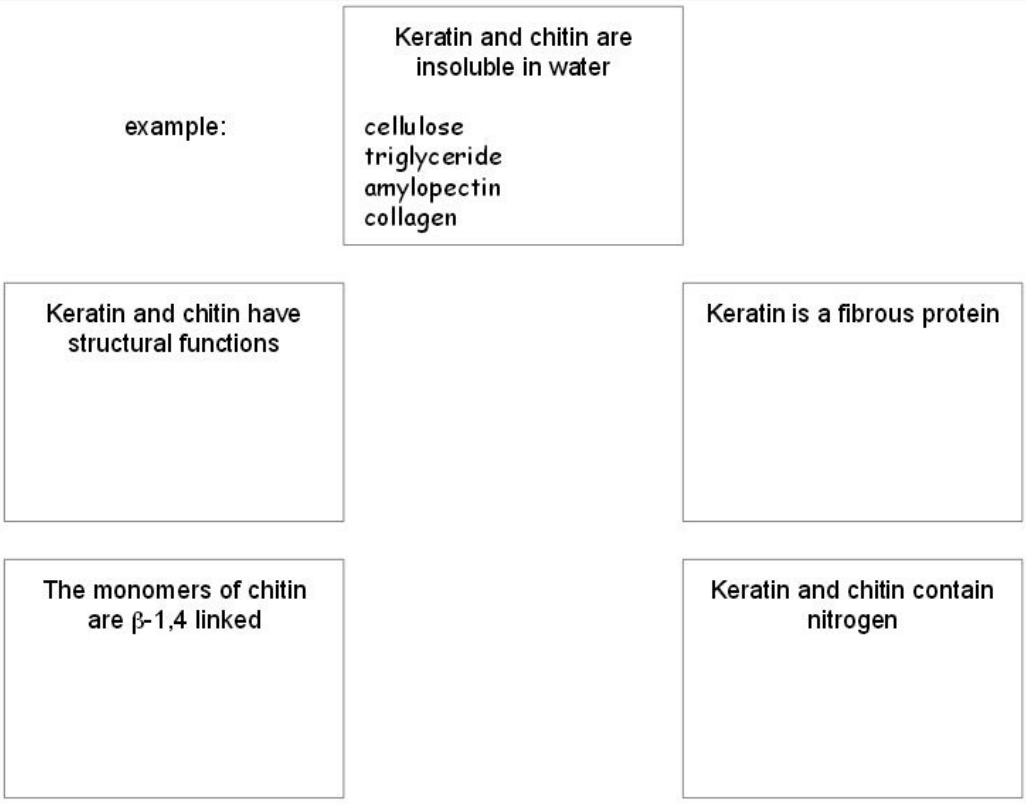


Fig. 2.1

Write, in each box, the biological molecules from the list below that have the same feature.

Each box may contain one, or more than one, biological molecule. The first box has been completed as an example.

amylopectin
cellulose
collagen
haemoglobin
mRNA
triglyceride

[5]

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Q.28.

5 **(a)** Describe the structure of a cellulose molecule **and** explain how cellulose is a suitable material for the cell walls of plants.

description

.....

.....

.....

.....

.....

explanation

.....

.....

.....

.....

..... **[4]**

Q.29.

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(c) Describe how a peptide bond is formed between two amino acids during polypeptide production.

You may use the space below to help with your answer.

.....

.....

.....

.....

.....

..... [3]

[Total: 8]

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Biological Molecules – AS 9700 Biology June 2022

1. June/2022/Paper_11/No.6

Samples of glucose, sucrose, and a mixture of glucose and sucrose were divided into two halves **M** and **N**.

M was then tested with Benedict's solution.

N was boiled with dilute hydrochloric acid, neutralised and then tested with Benedict's solution.

The colour of the solution was compared to colour standards.

Which table identifies the correct colour changes for these samples?

A

sample	M	N
glucose	blue	blue
sucrose	blue	yellow
mixture	blue	yellow

B

sample	M	N
glucose	yellow	yellow
sucrose	blue	yellow
mixture	blue	yellow

C

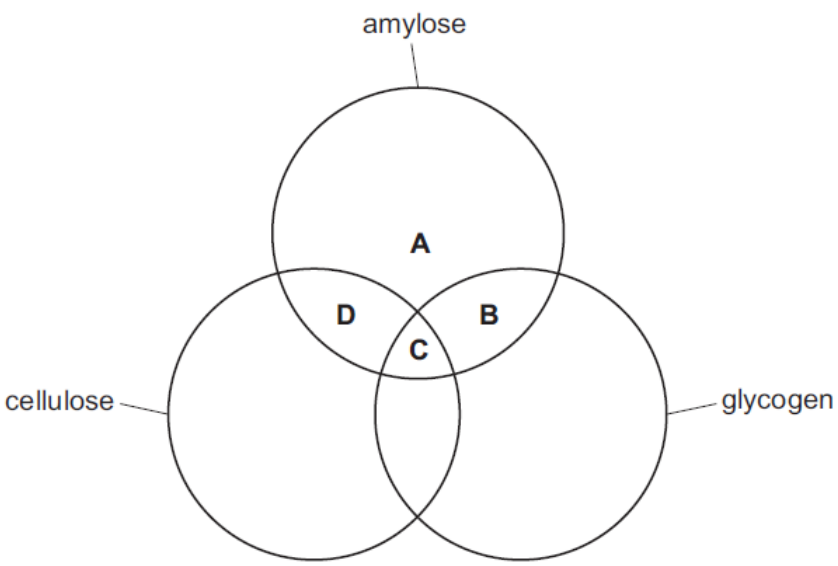
sample	M	N
glucose	yellow	yellow
sucrose	blue	yellow
mixture	yellow	red

D

sample	M	N
glucose	yellow	red
sucrose	blue	red
mixture	yellow	red

2. June/2022/Paper_11/No.7

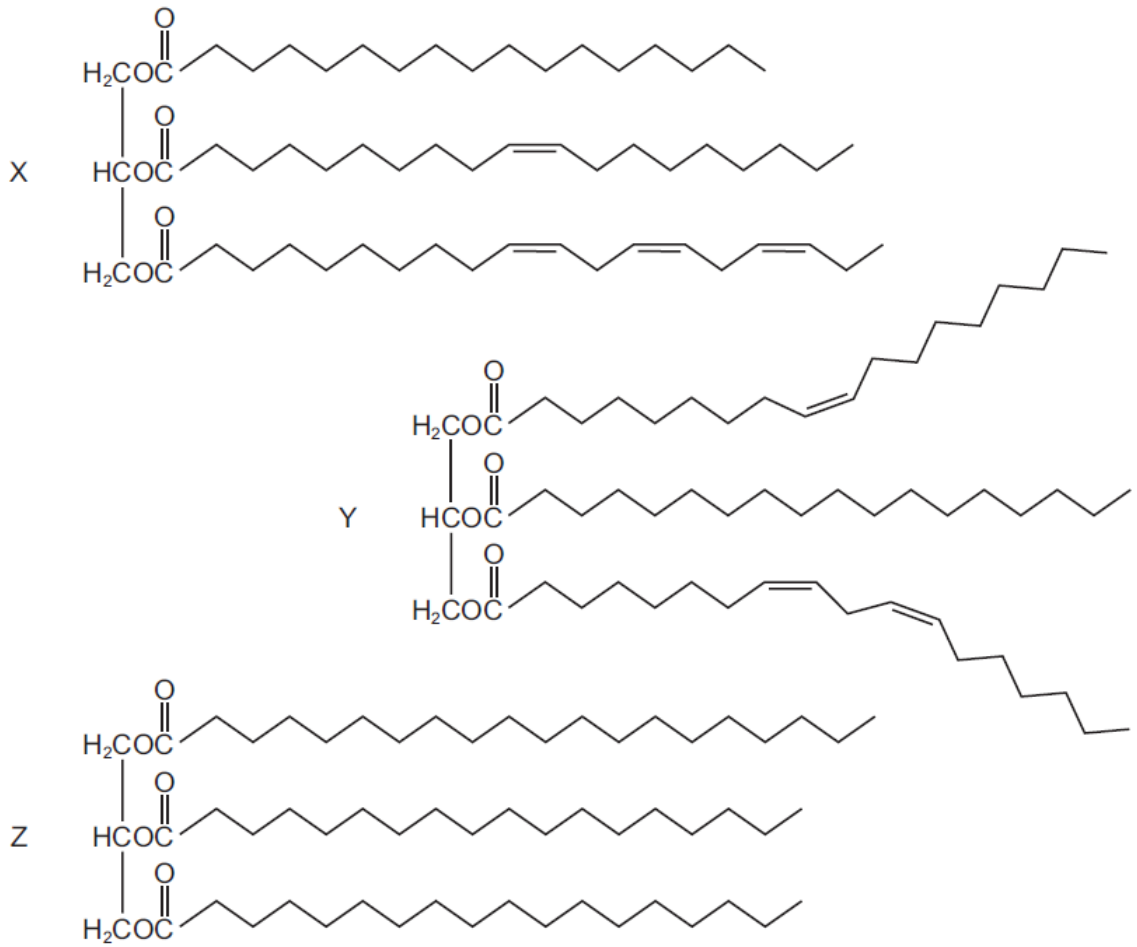
Which molecules contain 1,4-glycosidic bonds?



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3. June/2022/Paper_11/No.8

The diagram shows three triglycerides, X, Y and Z.



Which row is correct for these triglycerides?

	contains saturated fatty acids	contains unsaturated fatty acids	contains more than two different fatty acids
A	X, Y and Z	X and Y	X and Y
B	X, Y and Z	Z	X and Y
C	X and Y	X, Y and Z	X, Y and Z
D	Z	X and Y	X, Y and Z

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4. June/2022/Paper_11/No.9

Some foods contain hydrogenated vegetable fats. These are unsaturated fats that have been converted to saturated fats.

Which property of the fats will have changed?

A Their hydrocarbon chains will fit together more closely.

B Their solubility in water will increase.

C They will have more double bonds in their molecules.

D They will remain liquid at room temperature.

5. June/2022/Paper_11/No.10

A polypeptide contains a specific number of amino acids, n.

How many peptide bonds are present in this polypeptide?

A n – 1 **B** n **C** n + 1 **D** n + 2

6. June/2022/Paper_11/No.11

Which statement is correct?

A Amylase, ribose and phospholipid are all macromolecules.

B Cellulose, glucose and catalase are all polymers.

C Deoxyribose, fructose and ribose are all monosaccharides.

D Sucrose, deoxyribose and amylopectin are all polysaccharides.

7. June/2022/Paper_12/No.6

Four extracts from different plant materials were made and tested with Benedict's solution.

The extracts were boiled with Benedict's solution for 240 seconds and the final colour was recorded.

extract	colour produced after 240 seconds
1	red
2	yellow
3	blue
4	green

Which sequence of plant extracts represents an increasing quantity of reducing sugar?

A 1 → 2 → 4 → 3

B 3 → 1 → 2 → 4

C 3 → 2 → 1 → 4

D 3 → 4 → 2 → 1

8. June/2022/Paper_12/No.7

Which have properties that are dependent on hydrogen bonds?

1 cellulose

2 a molecule of haemoglobin

3 water

A 1, 2 and 3 **B** 1 and 2 only **C** 1 and 3 only **D** 2 and 3 only

9. June/2022/Paper_12/No.8

Which statement is correct?

A Cellulose, glycogen and amylopectin are all polymers.

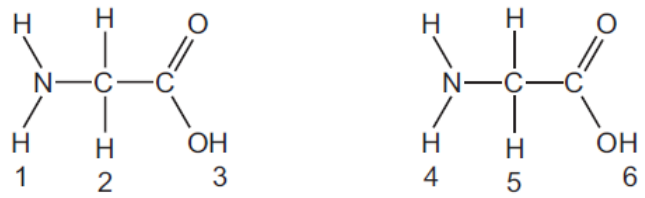
B Ribose, amylase and phospholipid are all macromolecules.

C Starch, glucose and amylose are all monomers.

D Sucrose, deoxyribose and amylopectin are all polysaccharides.

10. June/2022/Paper_12/No.9

The diagram shows two amino acids. Some of the hydrogen atoms are numbered 1 to 6.



Which two numbered hydrogen atoms could contribute to the production of a molecule of water when a peptide bond forms between these two amino acids?

A 1 and 4 **B** 1 and 6 **C** 3 and 5 **D** 2 and 4

11. June/2022/Paper_12/No.10

A student wrote four statements about water.

1 Water has a high specific heat capacity which maintains the temperature of water within cells.

2 Mammals rely on water having a relatively low latent heat of vaporisation to keep them cool.

3 When a negatively charged ion is added to water, the δ^+ charge on the hydrogen atom is attracted to the ion.

4 When surrounded by water, non-polar molecules tend to be pushed apart from one another.

Which statements are correct?

	1	2	3	4
A	✓	✗	✓	✓
B	✓	✗	✓	✗
C	✗	✓	✗	✓
D	✗	✓	✗	✗

key

✓ = correct

✗ = not correct

12. June/2022/Paper_13/No.7

The concentration of reducing sugar in a solution can be found if an observational measurement is compared to a standard.

Which observational measurement could be used to estimate the concentration of reducing sugar in an unknown solution?

1 the colour of the solution after 20 minutes

2 the time for the first colour change to occur

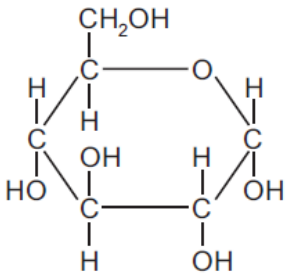
3 the rate of formation of solid particles

A 1, 2 and 3 **B** 1 and 2 only **C** 2 only **D** 3 only

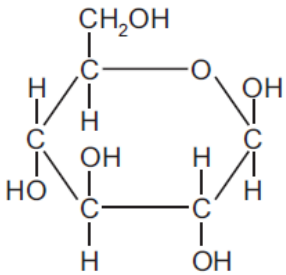
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13. June/2022/Paper_13/No.8

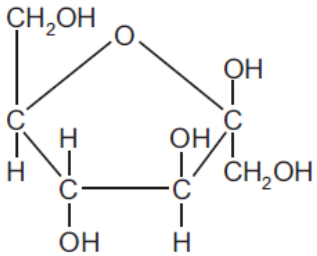
The diagram shows three hexose sugars.



1



2



3

Which row correctly shows examples of carbohydrates in which these three hexose sugars occur?

	sucrose	cellulose	amylopectin
A	1	2	3
B	1	3	2
C	2	3	1
D	3	2	1

14. June/2022/Paper_13/No.4

ATP molecules are synthesised in mitochondria.

Which sugar is found in these ATP molecules?

A deoxyribose

B fructose

C glucose

D pentose

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15. June/2022/Paper_13/No.9

Trehalose is a sugar that gives a negative result when tested with Benedict's solution.

A molecule of trehalose forms two α-glucose molecules when it is hydrolysed.

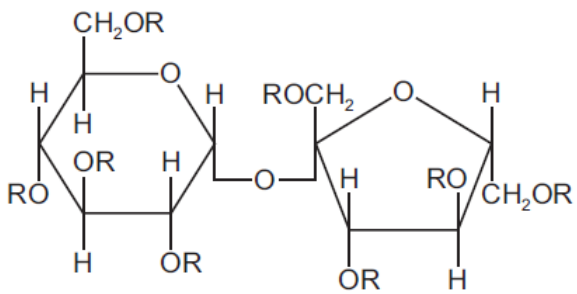
Which row is correct?

	formula of trehalose	sugar that gives the same result with Benedict's as trehalose
A	$C_{12}H_{22}O_{11}$	fructose
B	$C_{12}H_{22}O_{11}$	sucrose
C	$C_{12}H_{24}O_{12}$	fructose
D	$C_{12}H_{24}O_{12}$	sucrose

16. June/2022/Paper_13/No.10

Olestra is an artificial lipid. It is made by attaching fatty acids, by condensation, to a sucrose molecule.

A simplified diagram of olestra is shown. R represents the position where fatty acids would be attached.



Humans cannot hydrolyse olestra. However, other animals may be able to do so.

How many molecules of water would be needed to hydrolyse one molecule of olestra into fatty acids, fructose and glucose?

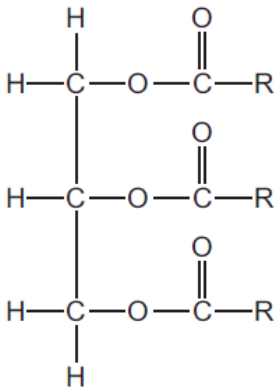
A 11 **B** 10 **C** 9 **D** 8

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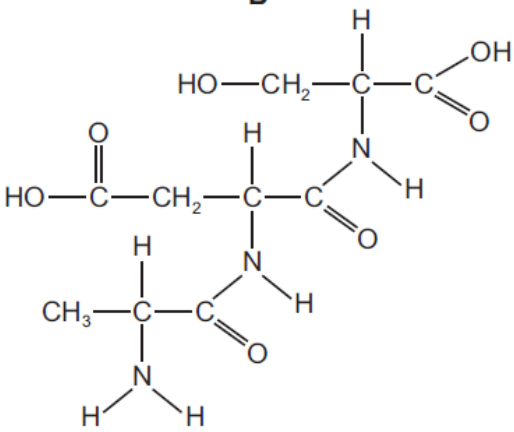
17. June/2022/Paper_13/No.11

Which molecule contains at least one peptide bond?

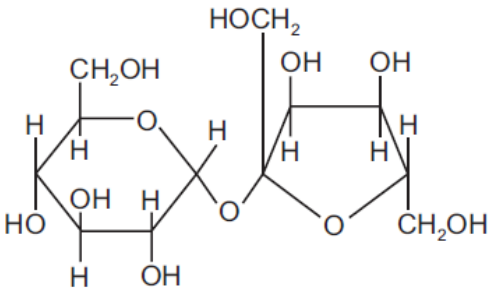
A



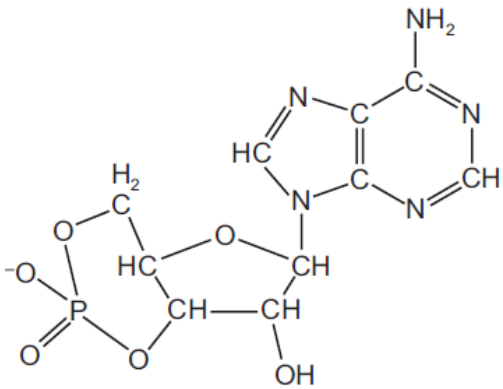
B



C



D



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18. June/2022/Paper_21/No.4

Adipocytes are cells found in adipose tissue in mammals. These cells absorb glycerol and fatty acids to make triglycerides for long-term storage.

Fig. 4.1a shows a glycerol molecule and three fatty acids. Fig. 4.1b shows the triglyceride molecule formed from these components.

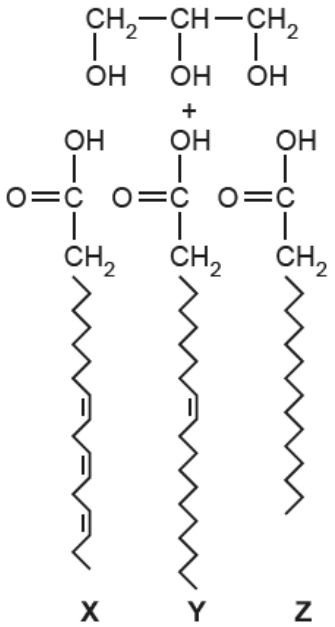


Fig. 4.1a

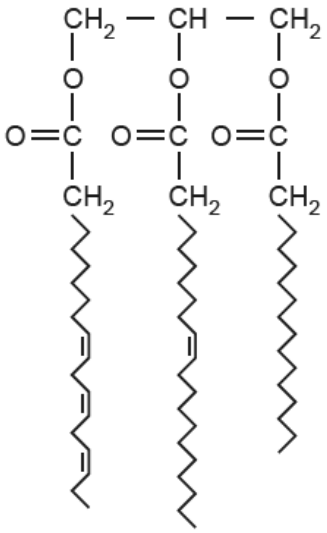


Fig. 4.1b

(a) (i) State the name of the bonds that form between glycerol and fatty acids.

..... [1]

(ii) When a bond forms between glycerol and a fatty acid, water is a product of the reaction.

State the name given to this type of reaction.

..... [1]

(iii) Describe the differences between the fatty acids, **X**, **Y** and **Z**, shown in Fig. 4.1a.

.....

.....

.....

.....

.....

.....

..... [3]

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(b) (i) State reasons why triglycerides are described as hydrophobic.

.....

.....

.....

.....

..... [2]

(ii) Explain why triglycerides are **not** suitable as a component of cell surface membranes.

.....

.....

.....

.....

..... [2]

[Total: 9]

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19. June/2022/Paper_21/No.3

Hummingbirds are the smallest of birds and are found in the Americas. Some species migrate hundreds of kilometres between warmer overwintering areas and summer breeding grounds. Like mammals, birds maintain a constant body temperature.

Hummingbirds have a high requirement for sugars because they have a very high metabolic rate. Fig. 3.1 shows a hummingbird feeding on nectar, one of their main food sources.



Fig. 3.1

(a) Nectar is a sugary liquid containing mainly sucrose, fructose and glucose.
Sucrose has the molecular formula $C_{12}H_{22}O_{11}$. Fructose and glucose each have the molecular formula $C_6H_{12}O_6$.

State **two** differences between sucrose and fructose, other than the number of carbon, hydrogen and oxygen atoms present.

.....

.....

.....

.....

..... [2]

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(b) In preparation for migration, sugars need to be converted to triglycerides to function as energy reserves. Hummingbirds can double their body mass during this time.

(i) Fig. 3.2 shows the structural formula of one type of storage triglyceride. The triglyceride has two types of fatty acid residue, palmitate and oleate.

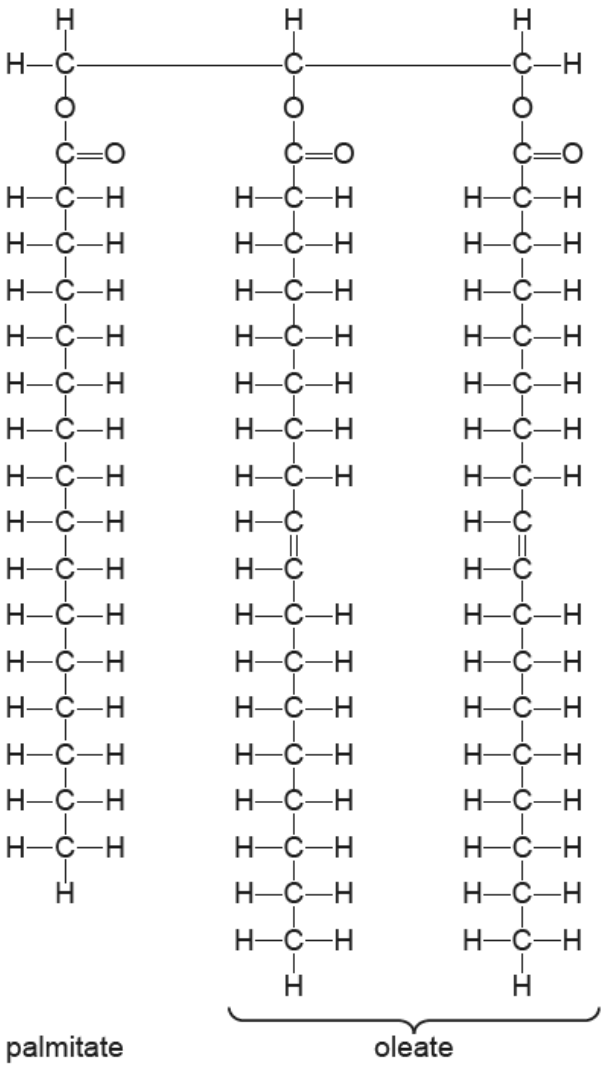


Fig. 3.2

Outline the features of the molecular structure of the triglyceride shown in Fig. 3.2.

.....

.....

.....

.....

.....

.....

.....

..... [3]

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(ii) In hummingbirds, glycogen is the long-term carbohydrate energy store.

Suggest **one** reason why hummingbirds build up a greater energy store in the form of triglyceride, rather than a greater energy store of glycogen, in preparation for migration.

.....

.....

..... [1]

(c) In birds such as hummingbirds:
- blood is kept within vessels
- for each complete circuit of the body, blood passes through the heart twice.

State the term used to describe this type of circulatory system.

..... [1]

(d) The heart of birds has the same structure as the heart of mammals. Compared with the heart of mammals, the heart of birds is larger in proportion to their body size.

Suggest why the heart of birds is larger in proportion to their body size.

.....

.....

.....

.....

..... [2]

(e) Complete Table 3.1 to show the names and functions of the main blood vessels associated with the heart of mammals.

Table 3.1

function of blood vessel	name of blood vessel
carries blood from the heart to the lungs	
carries blood to the heart from the lungs	
carries blood from the heart to the rest of the body	
carries blood to the heart from the rest of the body	

[3]

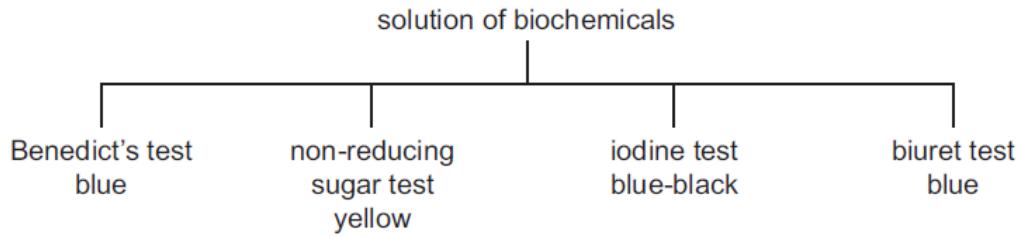
[Total: 12]

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Biological Molecules – AS 9700 Biology Nov 2022

1. Nov/2022/Paper_11/No.6

The diagram shows the results of a number of tests on a solution of biochemicals.



Which substances are present in the solution?

A non-reducing sugar and starch only

B protein, non-reducing sugar and starch

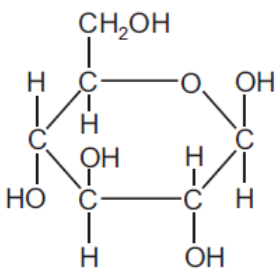
C starch and reducing sugar

D starch only

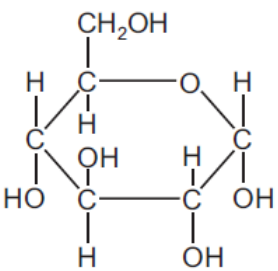
2. Nov/2022/Paper_11/No.7

Which diagram shows the ring form of β-glucose?

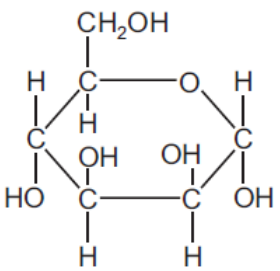
A



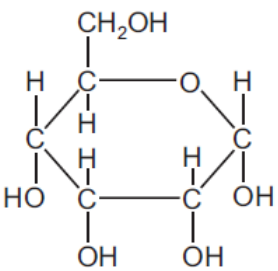
B



C



D



3. Nov/2022/Paper_11/No.8

Which row correctly matches the example with the type of molecule?

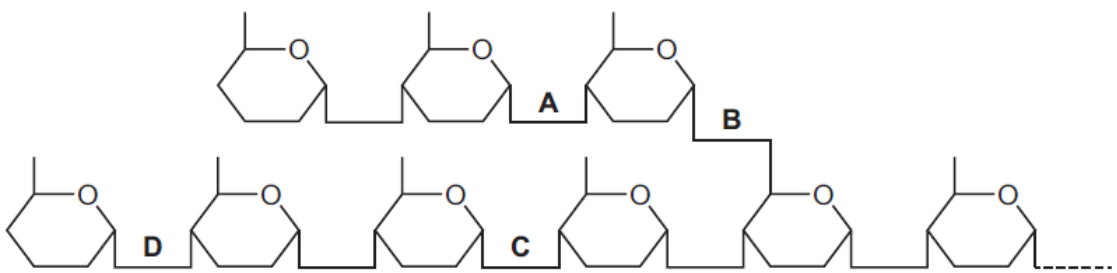
	disaccharide	macromolecule	monomer	polymer
A	fructose	glycogen	glucose	starch
B	starch	haemoglobin	ribose	glycogen
C	maltose	ribonucleic acid	sucrose	cellulose
D	sucrose	cellulose	fructose	collagen

4. Nov/2022/Paper_11/No.9

The enzyme α-amylase hydrolyses amylopectin but it is not able to hydrolyse some of its glycosidic bonds.

- It only hydrolyses 1,4 glycosidic bonds.
- It is not able to hydrolyse the last bond of a chain.
- It is not able to hydrolyse the bonds in a chain of three units attached by a 1,6 glycosidic bond to another chain.

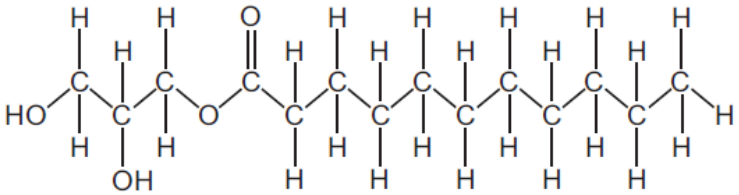
Which glycosidic bond can be hydrolysed by α-amylase?



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5. Nov/2022/Paper_11/No.10

Molecule X is a lipid.



molecule X

Which row is correct for molecule X and a triglyceride?

	molecule X contains	triglyceride contains
A	one unsaturated fatty acid	saturated fatty acids
B	no ester bonds	three ester bonds
C	one fatty acid	three fatty acids
D	two fatty acids	three fatty acids

6. Nov/2022/Paper_11/No.11

Bread contains a mixture of polypeptides known as gluten.

Two of the polypeptides found in gluten are glutenin and gliadin.

Which statement describes the tertiary structure of a protein?

A Disulfide bonds form between glutenin and gliadin.

B A large proportion of the amino acids in gliadin are glutamine.

C α-helical sections are found in glutenin and gliadin.

D Amino acids with hydrophobic R groups are found on the inside of glutenin.

7. Nov/2022/Paper_12/No.6

The table shows the observations recorded from tests for biological molecules on four samples, **A**, **B**, **C** and **D**.

Which conclusion is correct?

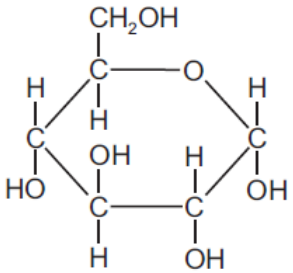
	Benedict's solution	biuret reagent	iodine solution	conclusion
A	blue	blue	blue-black	contains starch only
B	blue	purple	orange	contains reducing sugar only
C	green	blue	orange	contains reducing sugar and protein
D	red	blue	blue-black	contains starch and protein

8. Nov/2022/Paper_12/No.7

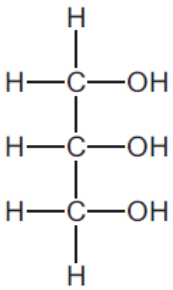
The diagrams show some biological molecules.

Which biological molecule forms a polymer with a structural role in plants?

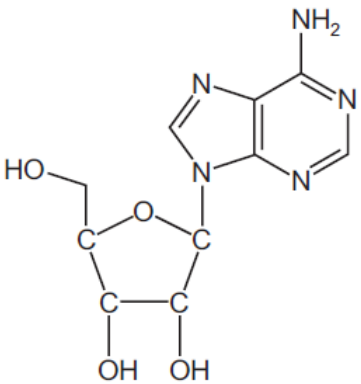
A



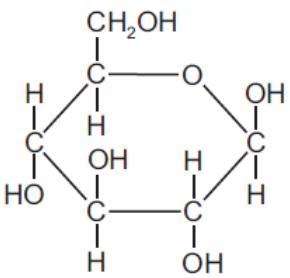
B



C



D



9. Nov/2022/Paper_12/No.8

Which molecule is a disaccharide **and** a reducing sugar?

A fructose

B glucose

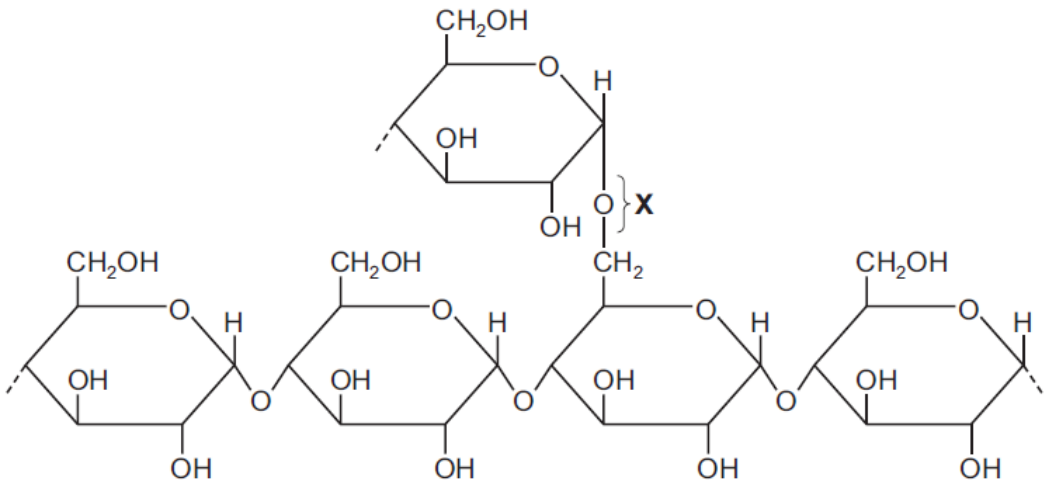
C maltose

D sucrose

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10. Nov/2022/Paper_12/No.9

The diagram shows bonding in part of a polysaccharide.



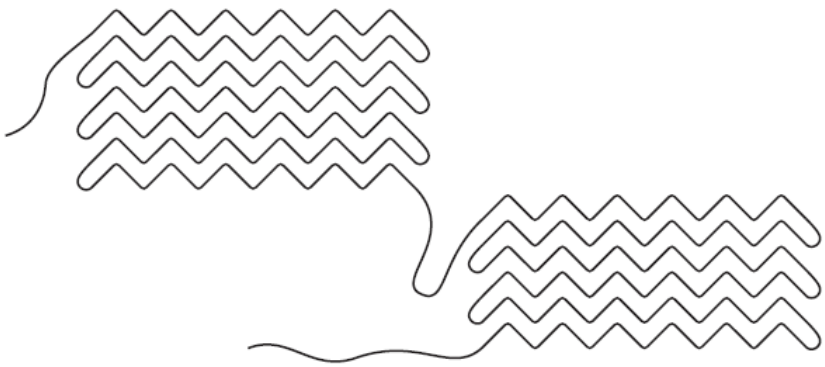
Which type of glycosidic bond is shown at position **X**?

A α-1,4 **B** α-1,6 **C** β-1,4 **D** β-1,6

11. Nov/2022/Paper_12/No.11

Silk moth caterpillars have been genetically modified to produce a mixture of their own silk and the much stronger spider silk of the golden orb web spider.

The spider silk polypeptide chain has many repeated sequences of two amino acids, glycine and alanine, arranged in a crystalline structure.



What correctly describes the structure of spider silk?

A primary protein structure with regions of α-helices

B secondary protein structure with regions of β-pleated sheets

C tertiary protein structure with regions of α-helices

D quaternary protein structure with regions of β-pleated sheets

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12. Nov/2022/Paper_12/No.12

Which property of the tertiary structure of a globular protein enables it to catalyse a metabolic reaction?

A It has hydrophobic amino acid R groups on the outside.

B It will be denatured by high temperatures.

C The R groups of some amino acids form bonds with a substrate.

D The three-dimensional shape depends on hydrogen bonding.

13. Nov/2022/Paper_13/No.6

The Benedict's test and ethanol emulsion test were carried out on a sample of biological molecules. The solution became brick-red during the Benedict's test and cloudy during the ethanol emulsion test.

Which molecules did the sample contain?

A reducing sugars and lipids

B proteins and reducing sugars only

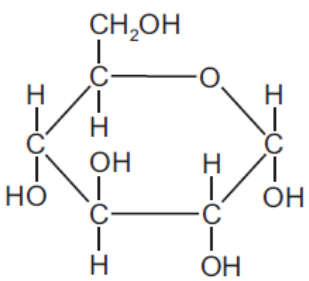
C starch, proteins and reducing sugars

D non-reducing sugars and lipids

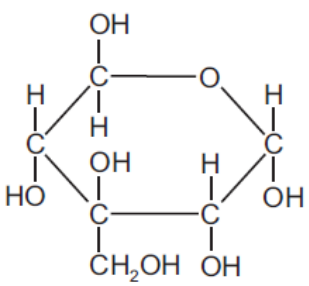
14. Nov/2022/Paper_13/No.7

Which diagram is correct for α-glucose?

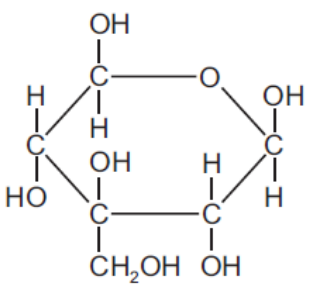
A



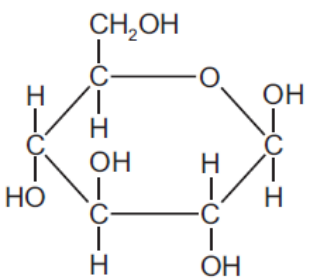
B



C



D



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15. Nov/2022/Paper_13/No.8

Which reaction correctly represents one way sucrose can form?

A (α-glucose – OH^-) + (fructose – H^+) → sucrose + H_2O

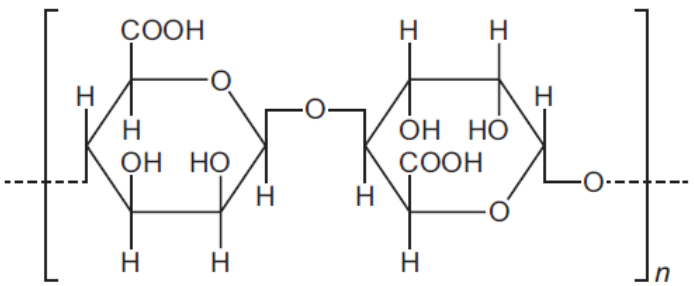
B (α-glucose + OH^-) + (α-glucose + H^+) → sucrose – H_2O

C (α-glucose – OH^-) + (β-glucose – H^+) → sucrose + H_2O

D (α-glucose + OH^-) + (fructose + H^+) → sucrose – H_2O

16. Nov/2022/Paper_13/No.9

The diagram represents part of an alginic acid molecule. Alginic acid is a polymer found in the cell walls of brown seaweeds.



Which statement about alginic acid is correct?

A Alginic acid is a linear polysaccharide containing 1,6 glycosidic bonds between each hexose sugar.

B Alginic acid is formed from two monomers joined by 1,4 glycosidic bonds.

C Alternate monosaccharides are arranged in opposite directions; this is also seen in glycogen molecules.

D Hexose sugars and water molecules are joined by condensation reactions to make alginic acid.

17. Nov/2022/Paper_13/No.10

Which features are correct for triglycerides **and** phospholipids?

1 They have ester bonds between glycerol and fatty acids.

2 Fatty acid chains may have single or double bonds between carbon atoms in the chains.

3 The fatty acid chains are non-polar and hydrophobic.

4 Saturated fatty acid chains allow closer packing of the molecules than unsaturated fatty acid chains.

A 1, 2, 3 and 4

B 1 and 3 only

C 2, 3 and 4 only

D 2 and 4 only

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18. Nov/2022/Paper_13/No.11

A scientist studying the structure of a protein reported that it consists of two polypeptide chains joined by disulfide bonds.

Which feature of protein structure does this describe?

A primary structure

B secondary structure

C tertiary structure

D quaternary structure

19. Nov/2022/Paper_13/No.12

Some molecules fluoresce when illuminated with ultraviolet light. Changes in the structure or shape of such molecules can change the intensity of the fluorescence.

The enzyme tryptophan synthase fluoresces bluish-green because of a phosphate group associated with the active site. The enzyme catalyses the reaction shown.

$$\text{serine} + \text{indole} \rightarrow \text{tryptophan}$$

Adding serine to the enzyme increases the intensity of the fluorescence, but when indole is also added the bluish-green fluorescence decreases in intensity.

What may be concluded from these observations?

1 Serine and indole attach to the active site of the enzyme.

2 An enzyme–serine complex is formed.

3 An enzyme–serine–indole complex is formed.

A 1, 2 and 3 **B** 1 and 2 only **C** 1 and 3 only **D** 2 and 3 only

20. Nov/2022/Paper_13/No.27

The statements describe some of the properties of water.

1 requires a lot of heat energy to evaporate

2 retains a lot of heat energy

3 is able to form hydrogen bonds with other water molecules

4 is able to form hydrogen bonds with other polar and non-polar molecules

Which properties are **also** important for transport in xylem?

A 1, 2 and 3 **B** 1, 2 and 4 **C** 1 and 3 only **D** 3 and 4

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21. Nov/2022/Paper_22/No.5(a)

Fibroblasts are one of the cell types of connective tissue. The cells synthesise and secrete collagen, which forms part of the supporting external cellular environment, known as the extracellular matrix.

(a) Fig. 5.1 shows the primary structure of a section of a polypeptide chain of collagen.

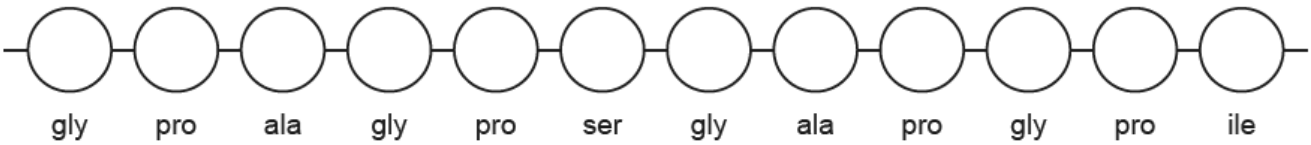


Fig. 5.1

Explain how the primary structure shown in Fig. 5.1 indicates that the structure of the polypeptide is suited to be a component of a collagen molecule.

.....

.....

.....

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.....

..... [3]

(b) After final processing in the Golgi body, collagen is released to the outer surface of the cell by exocytosis.

Complete the passage to describe the process of exocytosis.

After final processing in the Golgi body,.....

.....

.....

.....

.....

.....

.....

..... [3]

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(c) Hydrolytic enzymes, known as collagenases, are secreted by cells in an inactive form.

Cells also secrete inhibitors of collagenases. The activity of the enzymes and inhibitors is regulated so that the development and maintenance of the extracellular matrix is controlled.

(i) State **and** explain what the outcome will be for the composition of the extracellular matrix if collagenase inhibitor activity is needed.

.....

.....

.....

.....

..... [2]

(ii) Synthetic inhibitors have been trialled as potential treatment for diseases caused by a lack of regulation of collagenase activity.

Research involves investigating the mechanism of action of an inhibitor.

State the effect that a **non-competitive** inhibitor will have on the maximum rate of reaction, V_{max}, and the Michaelis–Menten constant, K_m, of collagenase.

V_{max} .....

K_m .....
[2]

[Total: 10]

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22. Nov/2022/Paper_23/No.1

(a) During translation, a polypeptide is synthesised when amino acids are added to a growing chain of amino acids.

Fig. 1.1 shows part of a growing chain of amino acids and the amino acid cysteine.

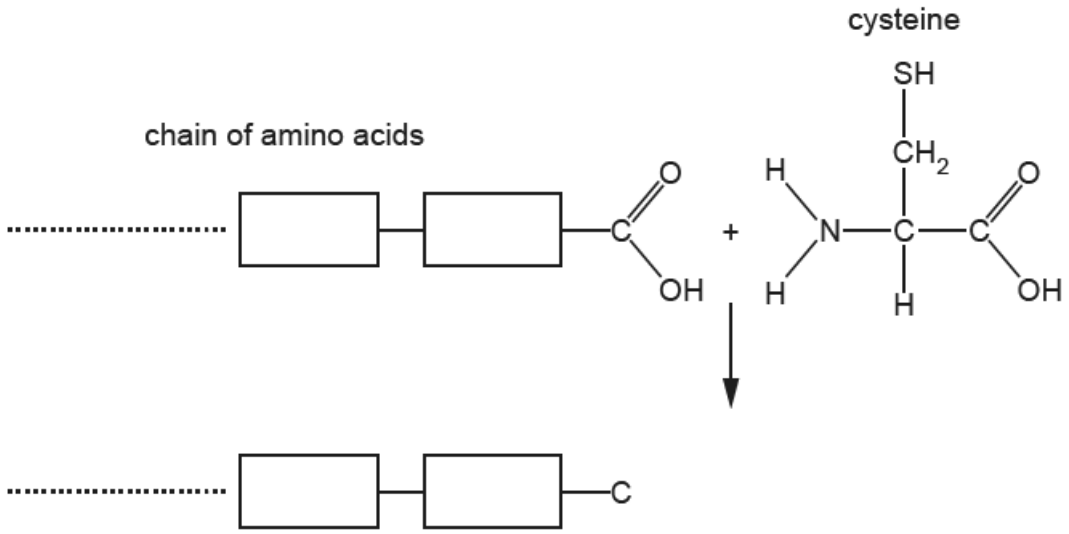


Fig. 1.1

(i) Complete Fig. 1.1 by showing the formation of the bond between cysteine and the growing chain of amino acids in the process of translation. [3]

(ii) State the name of the covalent bond that forms when cysteine is added to the growing chain of amino acids.

..... [1]

(iii) State the organelle where the reaction shown in Fig. 1.1 takes place.

..... [1]

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(b) Fig. 1.2 is a ribbon diagram showing the three-dimensional structure of a protein from the bacterium *Streptococcus*.

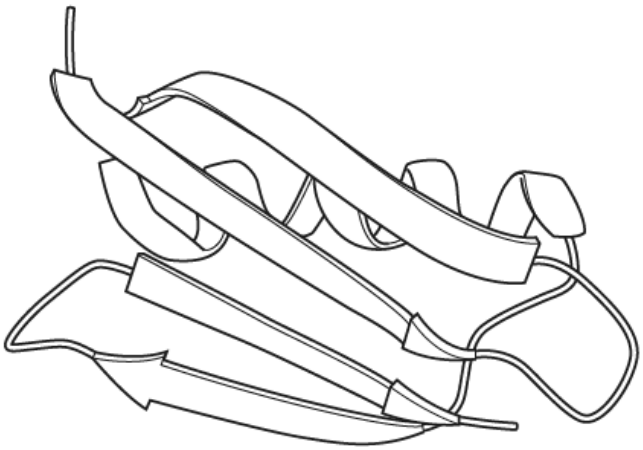


Fig. 1.2

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(i) Describe the secondary structure of the protein shown in Fig. 1.2.

.....

.....

.....

.....

..... [2]

(ii) Explain why the protein shown in Fig. 1.2 has tertiary structure, but not quaternary structure.

.....

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.....

.....

..... [2]

(iii) An analysis of the amino acid composition of the protein in Fig. 1.2 showed that it does **not** contain any cysteine residues.

Explain how the three-dimensional structure of the protein shown in Fig. 1.2 is held in place.

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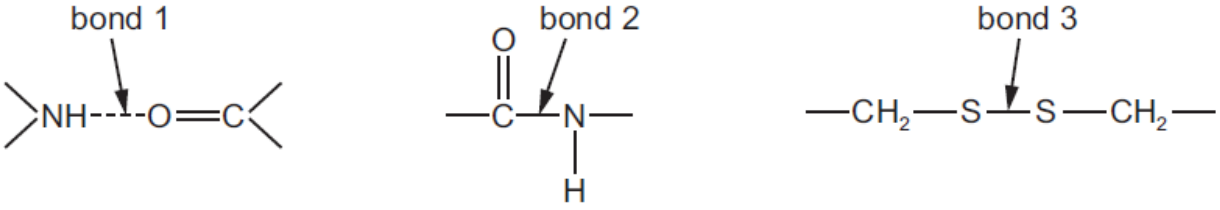
..... [3]

[Total: 12]

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1. June/2023/Paper_9700/11/No.9

The diagrams show three examples of different bonds.



Which bonds hold the secondary structure of proteins together?

A 1, 2 and 3 **B** 1 and 3 only **C** 1 only **D** 2 and 3 only

2. June/2023/Paper_9700/11/No.8

The table shows some steps that can be made in carrying out the Benedict's test.

Which combination of steps is required to carry out a semi-quantitative test on a reducing sugar solution?

	standardise volume of Benedict's solution and volume of test solution	boil with hydrochloric acid and then neutralise with alkali	standardise boiling time with Benedict's solution and compare final colour with numbered colour standards
A	✓	✗	✗
B	✗	✓	✗
C	✓	✗	✓
D	✗	✗	✓

key

✓ = step made

✗ = step not made

3. June/2023/Paper_9700/11/No.10

Insulin is a globular protein involved in cell signalling. It is transported in the blood plasma from the cells that synthesise it to its target cells. A molecule of insulin contains six sulfur-containing amino acids and has two polypeptide chains.

Which statements about insulin are correct?

1 An insulin molecule has a quaternary structure.

2 Insulin polypeptides are held together by six disulfide bonds.

3 Amino acids with hydrophobic R groups would be found in the centre of an insulin molecule.

A 1, 2 and 3 **B** 1 and 2 only **C** 1 and 3 only **D** 2 and 3 only

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4. June/2023/Paper_9700/12/No.6

Which polymers are present in all viruses **and** all prokaryotes?

1 polynucleotides

2 polypeptides

3 polysaccharides

A 1, 2 and 3 **B** 1 and 2 only **C** 1 and 3 only **D** 2 and 3 only

5. June/2023/Paper_9700/12/No.7

Which set of steps is the best method for conducting the emulsion test for lipids?

A Add 2 cm^3 of water to the sample.
Pour the water into a test-tube containing 2 cm^3 of ethanol.
Lipids are present if the mixture becomes cloudy.

B Add 2 cm^3 of ethanol to the sample and shake.
Pour the ethanol into a test-tube containing 2 cm^3 of water and boil.
Lipids are present if the mixture becomes clear.

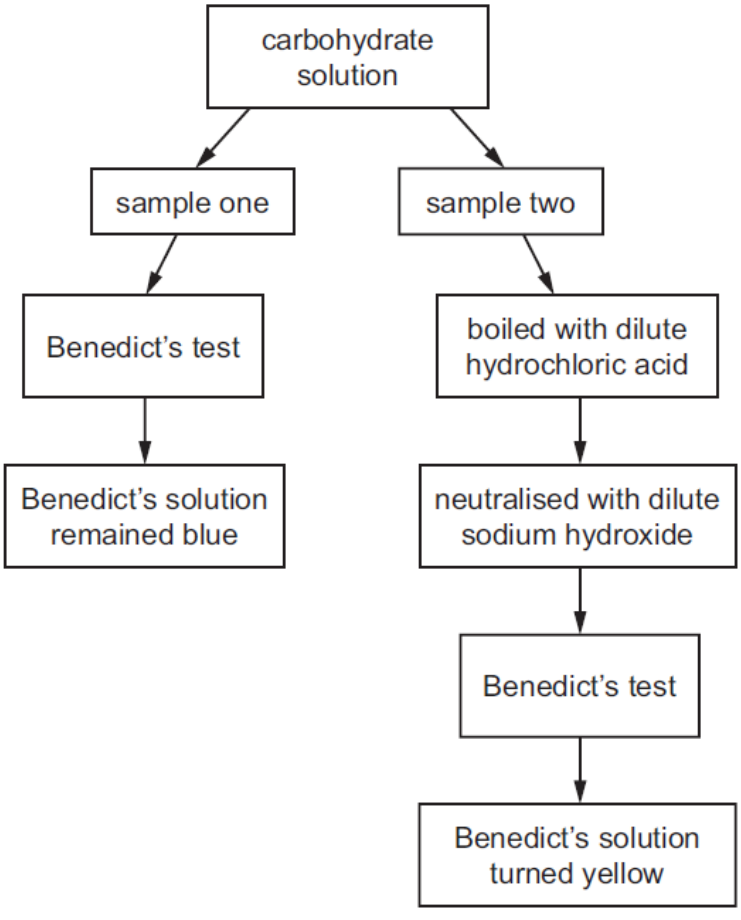
C Add 2 cm^3 of water to the sample and shake.
Pour the water into a test-tube containing 2 cm^3 of ethanol and boil.
Lipids are present if the mixture becomes cloudy.

D Add 2 cm^3 of ethanol to the sample and shake.
Pour the ethanol into a test-tube containing 2 cm^3 of water and shake again.
Lipids are present if the mixture becomes cloudy.

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6. June/2023/Paper_9700/12/No.8

A student was provided with a solution of carbohydrate. They removed two samples from the solution and performed tests on each sample, as shown.



Which statement explains the results?

A Condensation reactions occur in sample two to release reducing sugar.

B Glycosidic bonds in a polysaccharide have been broken to release reducing sugar.

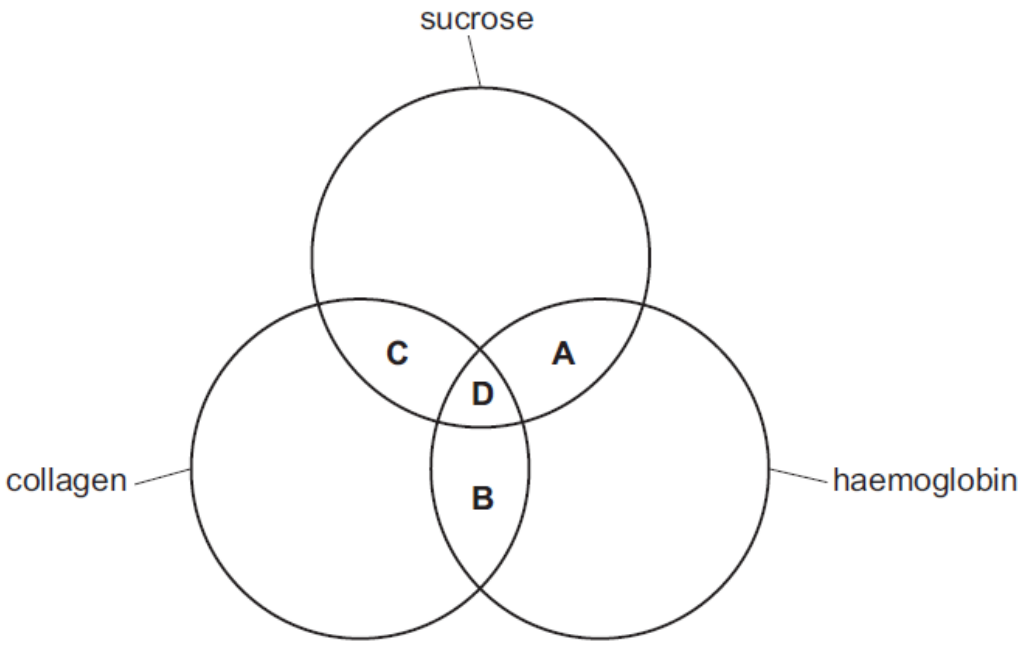
C Sample one shows that sucrose is present in the carbohydrate solution.

D The change in colour to a yellow solution shows that glucose is present.

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7. June/2023/Paper_9700/12/No.9

Which molecules contain at least two double bonds?



8. June/2023/Paper_9700/12/No.10

What describes cellulose?

A a branched chain of 1-4 α-glucose

B a branched chain of 1-4 β-glucose

C an unreactive linear chain of 1-4 α-glucose

D an unreactive linear chain of 1-4 β-glucose

9. June/2023/Paper_9700/12/No.11

Which part of the structure of haemoglobin carries oxygen?

A four polypeptide chains

B haem groups

C hydrogen bonds

D hydrophilic R groups

10. June/2023/Paper_9700/12/No.12

What is the maximum number of hydrogen bonds that can form between two single water molecules?

A 1 **B** 2 **C** 3 **D** 4

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11. June/2023/Paper_9700/13/No.7

Steps 1, 2, 3 and 4 are used to test for a non-reducing sugar.

1 Put 5 cm^3 of solution into a test-tube.

2 Add a few drops of acid.

3 Neutralise with alkali.

4 Add 6 cm^3 of Benedict's solution.

When is the solution heated or boiled?

A between steps 1 and 2

B between steps 2 and 3, and after step 4

C between steps 2 and 3 only

D after step 4 only

12. June/2023/Paper_9700/13/No.8

Which features contribute to the function of a cellulose molecule?

1 Long chains of glucose molecules coil into a helix.

2 Many hydrogen bonds form between adjacent chains.

3 It is insoluble in water.

A 1, 2 and 3 **B** 1 and 3 only **C** 2 and 3 only **D** 2 only

13. June/2023/Paper_9700/13/No.9

What correctly describes triglycerides?

A non-polar molecules that are soluble in ethanol

B non-polar molecules that are soluble in water

C polar molecules that are soluble in ethanol

D polar molecules that are soluble in water

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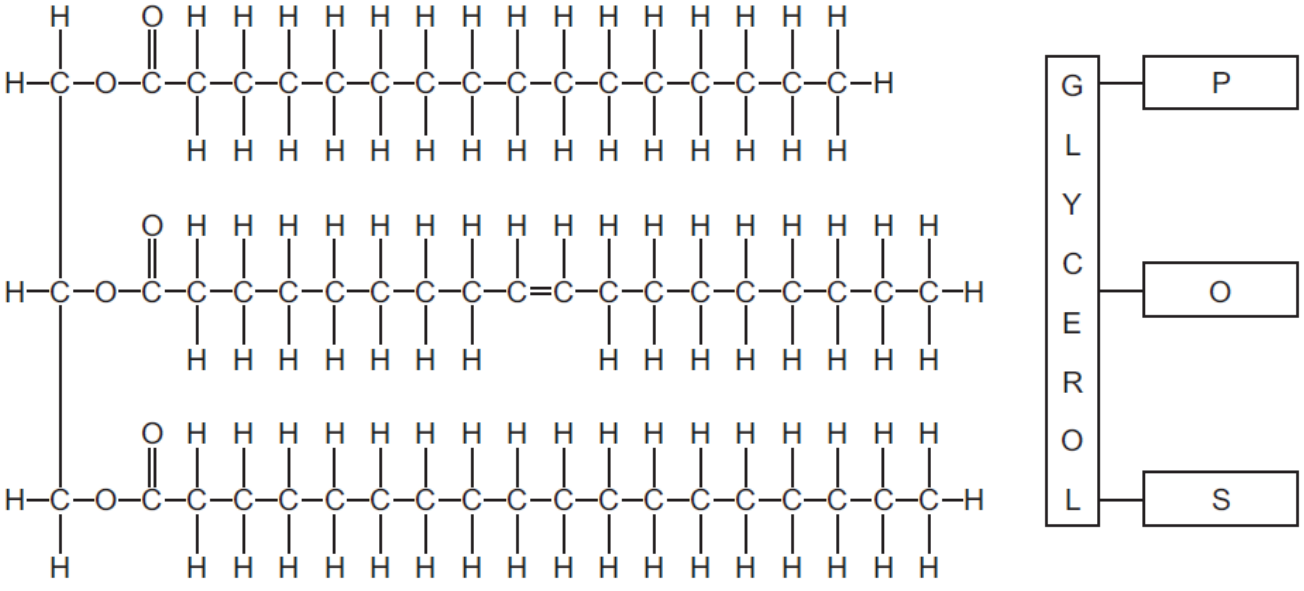
14. June/2023/Paper_9700/13/No.10

Cocoa butter contains three different triglycerides. These triglycerides are made from the fatty acids:

- oleic acid (O)
- palmitic acid (P)
- stearic acid (S).

The three triglycerides found in cocoa butter are POS, SOS and POP.

The chemical structure of the triglyceride POS is shown next to a diagrammatic representation of POS.



Which statement is correct?

A Triglyceride POP contains two unsaturated fatty acids joined by ester bonds to glycerol.

B Triglyceride POS contains two less carbon atoms than triglyceride POP.

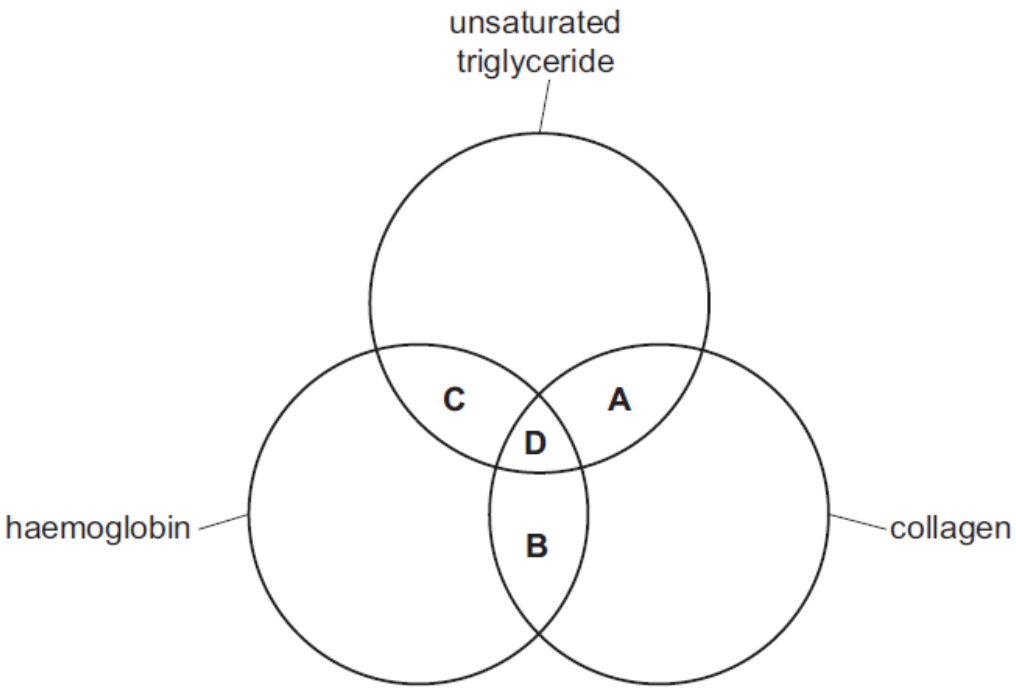
C Triglyceride SOS contains four more carbon atoms than triglyceride POP.

D Triglyceride SOS contains two saturated fatty acids joined by hydrolysis to glycerol.

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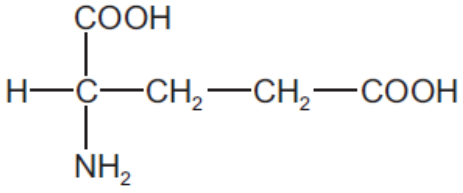
15. June/2023/Paper_9700/13/No.11

Which molecules contain at least four double bonds?



16. June/2023/Paper_9700/13/No.12

The diagram shows the amino acid glutamic acid.



What is the R group for glutamic acid?

A NH_2

B H

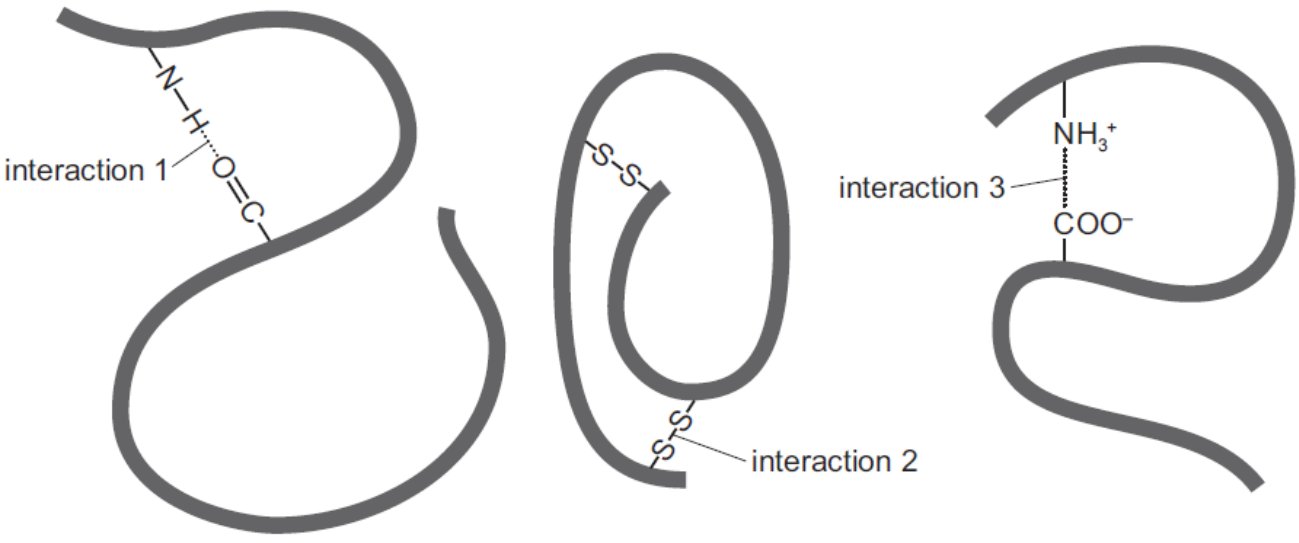
C COOH

D $CH_2—CH_2—COOH$

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17. June/2023/Paper_9700/13/No.13

The diagram shows three interactions that hold protein molecules in shape.



Which row identifies these interactions?

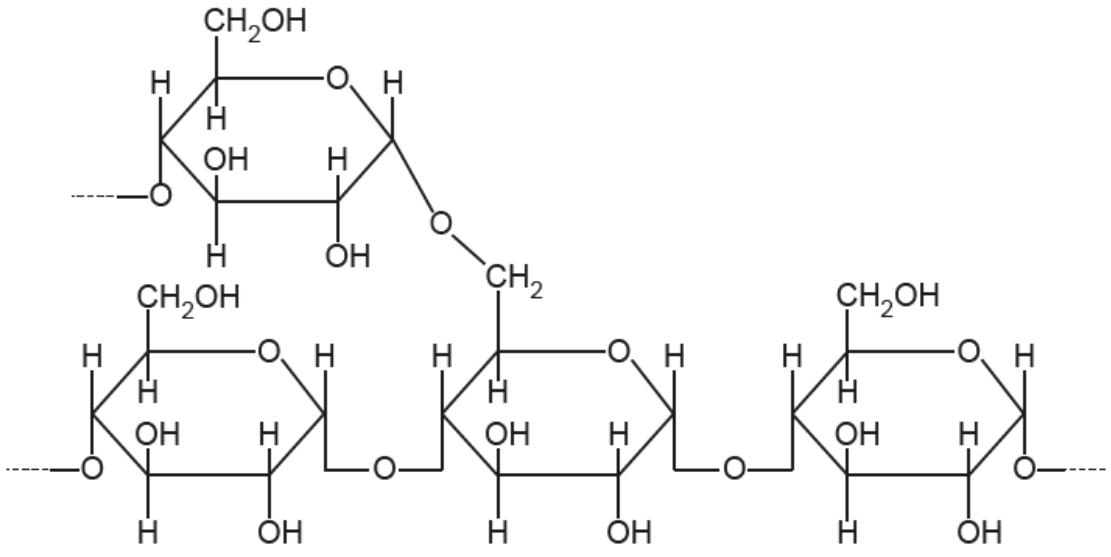
	interaction 1	interaction 2	interaction 3
A	hydrogen bond	disulfide bond	hydrophobic interaction
B	hydrogen bond	covalent bond	ionic bond
C	hydrophobic interaction	ionic bond	hydrogen bond
D	ionic bond	disulfide bond	peptide bond

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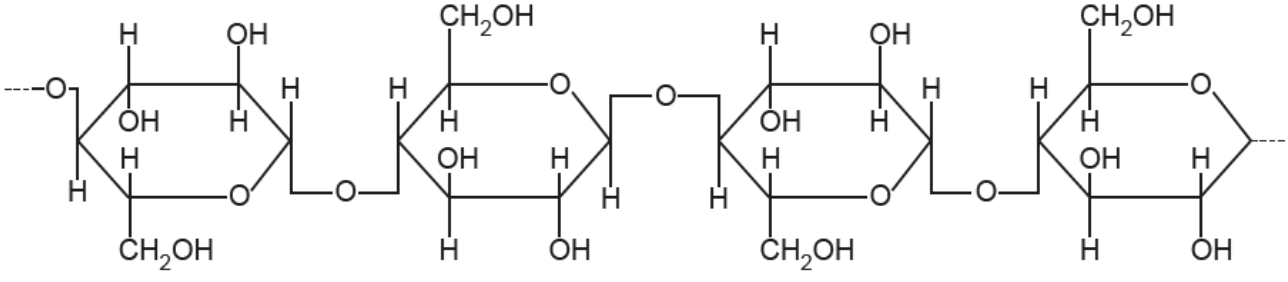
18. June/2023/Paper_9700/21/No.2

Glycogen and cellulose are polymers.

Fig. 2.1 shows small, representative regions of a glycogen molecule and a cellulose molecule.



glycogen



cellulose

Fig. 2.1

(a) Describe **three** ways, **visible in Fig. 2.1**, in which the molecule of glycogen differs from the molecule of cellulose.

1 .....

.....

2 .....

.....

3 .....

.....

[3]

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(b) Glycogen is found in the form of granules in mammalian liver and muscle cells. Fig. 2.2 is a diagram of part of a molecule of glycogen isolated from a glycogen granule.

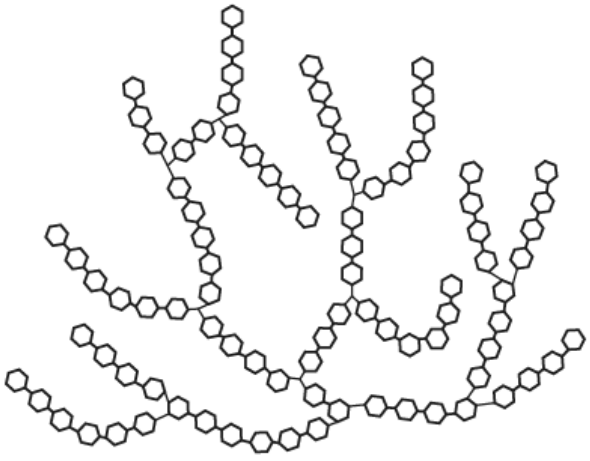


Fig. 2.2

Explain how the structure of glycogen is related to its function in cells.

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.....

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.....

..... [3]

(c) Explain how the arrangement of cellulose molecules in plant cell walls is related to their function.

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..... [3]

[Total: 9]

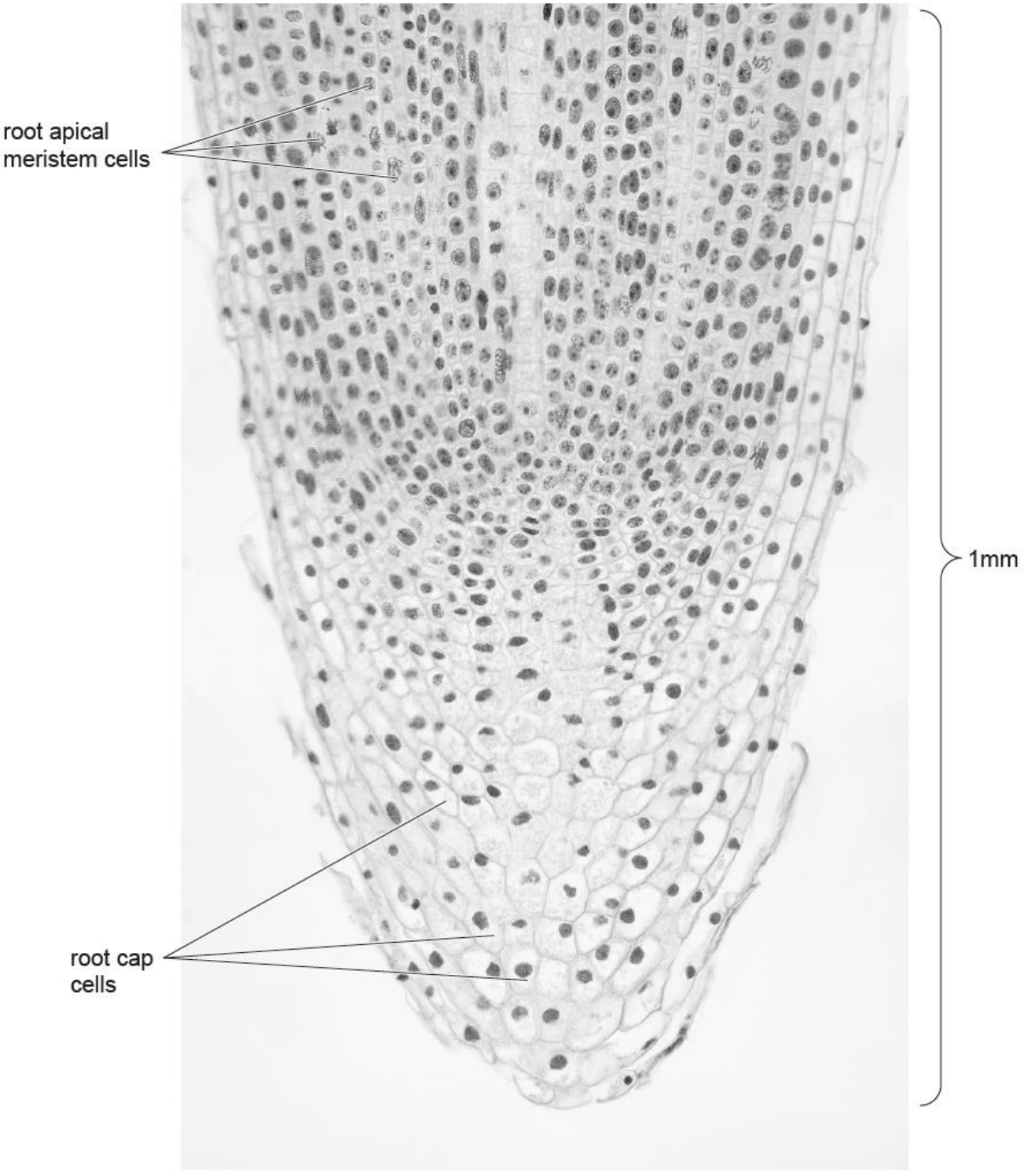
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19. June/2023/Paper_9700/22/No.2

Fig. 2.1 is a photomicrograph of a longitudinal section (LS) through a root tip. Two different regions are visible:

- the root apical meristem
- the root cap.

Cells in the root cap synthesise a gel-like, sticky secretion known as mucilage, which is important in reducing friction between soil and the growing root. It is composed mainly of polysaccharides and also contains some amino acids and enzymes.



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(a) Describe **three** differences, **visible** in Fig. 2.1, between root apical meristem cells and root cap cells.

1 .....

.....

.....

.....

2 .....

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.....

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3 .....

.....

.....

.....

[3]

(b) Mucilage acts as a glue to bind tiny soil particles together, forming small clumps close to the root. These small clumps help to maintain the soil water around the root tip and prevent the loss of water.

With reference to the cohesive **and** adhesive properties of water, suggest **and** explain how the formation of small clumps of soil helps to maintain the soil water around the root tip.

.....

.....

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.....

.....

.....

.....

..... [3]

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(c) Enzymes present in mucilage catalyse the breakdown of organic compounds in the soil. This increases the presence of mineral ions in the soil.

State the term used to describe enzymes that act **outside** the cells that synthesise them.

..... [1]

(d) The polysaccharides and amino acids present in the mucilage are a source of nutrients for soil microorganisms that live in the area surrounding the root. Some of these microorganisms can break down soil compounds to release mineral ions.

(i) Explain what is meant by a polysaccharide.

.....

.....

.....

.....

..... [2]

(ii) The soil microorganisms use amino acids to synthesise proteins. All of the twenty different amino acids that are present in proteins have the same general structure.

Draw the general structure of an amino acid in the space provided **and** use this drawing to explain how it is possible to have many different amino acids.

.....

.....

..... [2]

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(iii) Mineral ions are usually present in the soil in very low concentrations. The action of mucilage enzymes and soil microorganisms can help to increase the presence of mineral ions.

Root hair cells are specialised for the uptake of these mineral ions **and** for the absorption of water from the soil.

Suggest **and** explain how the presence of mineral ions in the root hair cell can **increase** the absorption of water by the root hair cells.

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..... [3]

[Total: 14]

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20. June/2023/Paper_9700/23/No.6

Polysaccharides, such as glycogen, are composed of thousands of monomers.

Oligosaccharides are carbohydrates that contain three to ten monomers in their chain.

(a) Nystose is one example of an oligosaccharide. The structure of nystose is shown in Fig. 6.1.

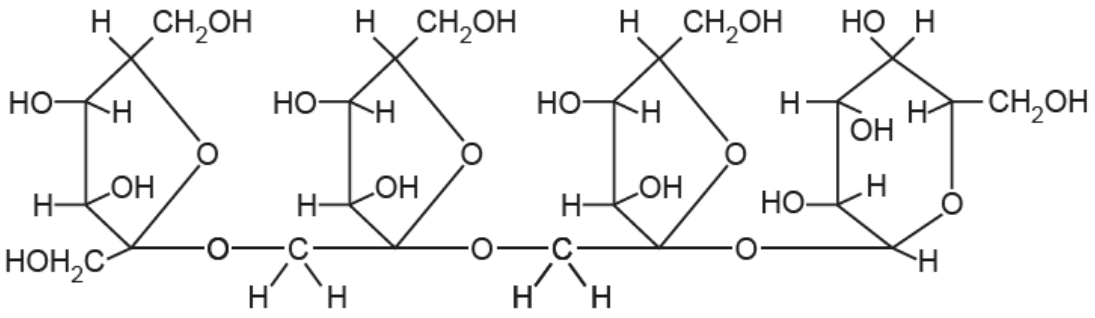


Fig. 6.1

State **three** differences between the structures of nystose and glycogen, **other** than the number of monomers in the molecules.

1 .....

.....

.....

2 .....

.....

.....

3 .....

.....

.....

[3]

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(b) Cells use oligosaccharides to synthesise glycoproteins, which are transported to cell surface membranes.

Describe the roles of the rough endoplasmic reticulum and the Golgi body in synthesising glycoproteins.

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..... [4]

(c) State **one** role of glycoproteins in the cell surface membrane.

.....

..... [1]

[Total: 8]

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21. March/2023/Paper_9700/12/No.7

To estimate the concentration of glucose in an unknown solution, equal volumes of a range of known concentrations of glucose were each mixed with the same excess volume of Benedict's solution. After mixing, the solutions were placed in a thermostatically controlled water-bath at 90 °C for three minutes.

The unknown solution was then treated in the same way and the colours of the known and unknown solutions compared.

What is the independent variable in this procedure?

A concentration of glucose

B final colour of solutions

C temperature of water-bath

D volume of glucose solutions

22. March/2023/Paper_9700/12/No.8

Which statements are correct for amylose and also for amylopectin?

1 They are carbohydrate molecules.

2 They are formed by condensation reactions.

3 They are linear molecules.

4 They contain α-1,4 glycosidic bonds.

A 1, 2 and 3 **B** 1, 2 and 4 **C** 1, 3 and 4 **D** 2, 3 and 4

23. March/2023/Paper_9700/12/No.9

Which statement is a correct comparison between saturated triglyceride molecules and unsaturated triglyceride molecules of approximately the same molecular masses?

A Unsaturated triglycerides have more double bonds and fewer hydrogen atoms than saturated triglycerides.

B Unsaturated triglycerides have fewer double bonds and fewer hydrogen atoms than saturated triglycerides.

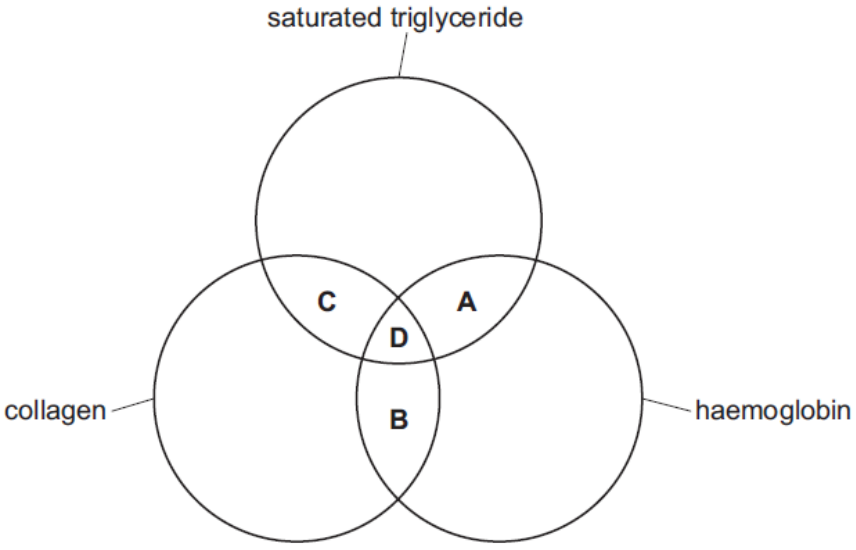
C Unsaturated triglycerides have more double bonds and more hydrogen atoms than saturated triglycerides.

D Unsaturated triglycerides have fewer double bonds and more hydrogen atoms than saturated triglycerides.

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24. March/2023/Paper_9700/12/No.12

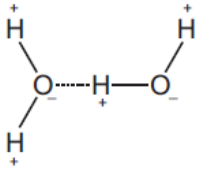
Which molecules contain at least three double bonds?



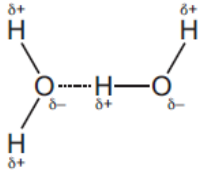
25. March/2023/Paper_9700/12/No.13

Which diagram correctly shows hydrogen bonding between two water molecules?

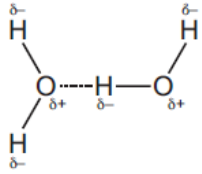
A



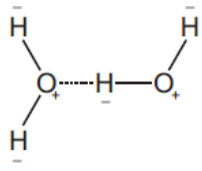
B



C



D



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26. March/2023/Paper_9700/22/No.2

(a) Cysteine is an amino acid containing sulfur. Fig. 2.1 shows the structure of the molecule formed by joining two cysteine molecules together.

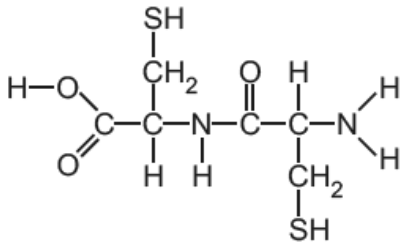


Fig. 2.1

Draw a circle around an R-group in the molecule shown in Fig. 2.1. [1]

(b) Goblet cells in the human gas exchange system produce proteins called mucins.

(i) The ends of mucin molecules contain many cysteine residues. Mucin strands are formed by joining the ends of mucin molecules together through covalent bonds between R-groups.

State the name of these covalent bonds.

..... [1]

(ii) Mucin strands are transported out of the goblet cells and then absorb water to form mucus.

Suggest **and** explain how mucin strands are transported out of the goblet cells.

.....

.....

.....

.....

.....

.....

..... [3]

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Cystic fibrosis is a genetic disease caused by a mutation in the human *CFTR* gene. This results in mucus that is thicker than normal.

(c) Suggest how thicker mucus interferes with the maintenance of healthy gas exchange surfaces in the lungs.

.....

.....

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.....

..... [2]

(d) Row 1 and row 2 of Table 2.1 show the DNA base sequences of part of the normal *CFTR* allele and the same part of a mutated *CFTR* allele. The base sequences shown are for the DNA strands used in the synthesis of RNA. When Table 2.1 is completed, row 3 will show the base sequence of the RNA synthesised from the same part of the mutated *CFTR* allele.

Table 2.1

1	DNA base sequence of part of the normal *CFTR* allele	T	A	G	T	A	G	A	A	A	C	C	A
2	DNA base sequence of part of the mutated *CFTR* allele	T	A	G	T	A	A	C	C	A	C	A	A
3	RNA base sequence synthesised from the mutated *CFTR* allele												

(i) The difference between the DNA base sequence in row 1 and the DNA base sequence in row 2 of Table 2.1 is caused by a single gene mutation.

State the name of this type of gene mutation.

..... [1]

(ii) Row 1 and row 2 in Table 2.1 show the DNA strands used in the synthesis of RNA.

State the term used to describe the DNA strand that is used in the synthesis of RNA.

..... [1]

(iii) Complete Table 2.1 to show the missing bases in row 3. [1]

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(iv) The normal *CFTR* allele is approximately 189 000 base pairs in length. The CFTR polypeptide consists of only 1480 amino acids.

Explain the reasons for this difference between the number of base pairs and the number of amino acids.

.....

.....

.....

.....

.....

.....

..... [3]

[Total: 13]

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Biological Molecules – AS 9700 November 2023

1. Nov/2023/Paper_ 9700/11/No.8

The test for non-reducing sugars requires a second Benedict's test to be carried out.

Which set of steps is the correct method for carrying out the non-reducing sugar test **before** carrying out the second Benedict's test?

A Perform the Benedict's test, which gives a negative result.
Warm gently with dilute hydrochloric acid.
Neutralise with sodium hydrogencarbonate.

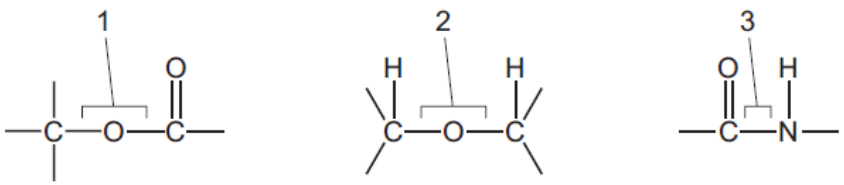
B Perform the Benedict's test, with the colour of the solution remaining red.
Boil with dilute hydrochloric acid.
Neutralise with sodium hydrogencarbonate.

C Perform the Benedict's test, with the colour of the solution remaining blue.
Boil with dilute hydrochloric acid.
Neutralise with sodium hydrogencarbonate.

D Perform the Benedict's test, which gives a negative result.
Neutralise with sodium hydrogencarbonate.
Warm gently with dilute hydrochloric acid.

2. Nov/2023/Paper_ 9700/11/No.9

The diagrams show three types of covalent bonds.



Which bonds will be found in glycolipids and glycoproteins?

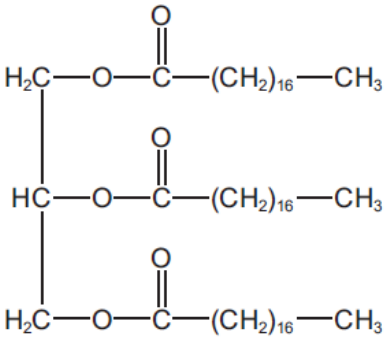
	bond 1	bond 2	bond 3
A	glycolipids only	glycolipids and glycoproteins	glycoproteins only
B	glycolipids and glycoproteins	glycolipids only	glycoproteins only
C	glycoproteins only	glycolipids only	glycolipids and glycoproteins
D	glycoproteins only	glycolipids and glycoproteins	glycolipids only

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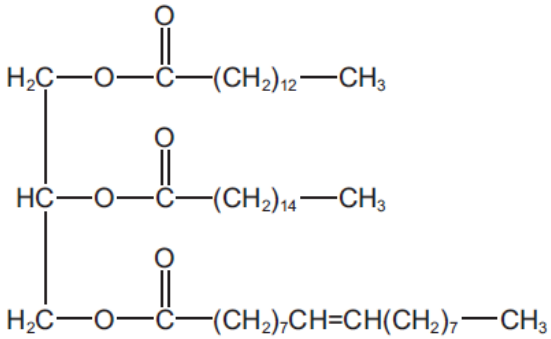
3. Nov/2023/Paper_ 9700/11/No.10

Which molecules would be found in an oil (liquid) more than in a fat (solid)?

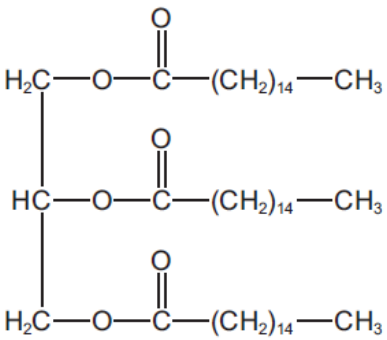
1



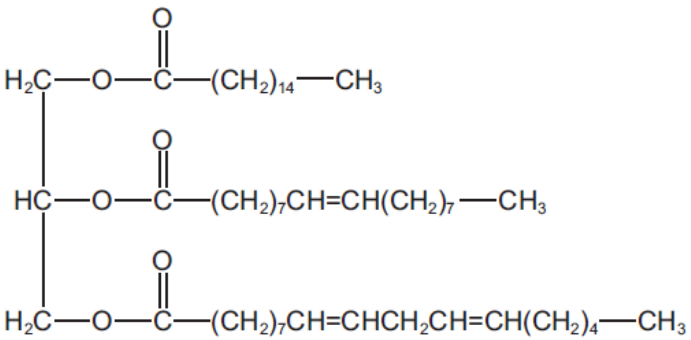
2



3



4



A 1 and 3 **B** 1 and 4 **C** 2 and 3 **D** 2 and 4

4. Nov/2023/Paper_ 9700/11/No.11

Which row about the bonding found in the primary, secondary, tertiary and quaternary structure of proteins is correct?

	primary	secondary	tertiary	quaternary
A	covalent	covalent	ionic and disulfide only	hydrogen and hydrophobic interactions only
B	covalent	hydrogen	hydrogen, ionic, covalent and hydrophobic interactions	hydrogen, ionic, covalent and hydrophobic interactions
C	peptide	covalent	hydrogen, ionic, disulfide and hydrophobic interactions	hydrogen, ionic and disulfide
D	peptide	hydrogen	ionic and disulfide only	ionic and disulfide only

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5. Nov/2023/Paper_ 9700/11/No.12

The specific heat capacity of different substances is shown.

substance	specific heat capacity / $J\,g^{-1}\,°C$
air	1.0
hydrogen gas	14.3
water (liquid)	4.2
water (steam)	2.1

Which statement is correct?

A Air is a more stable environment than water because it is more resistant to changes in temperature.

B It takes more energy to raise the temperature of hydrogen gas than it does to raise the temperature of water.

C A specific heat capacity of $4.2\,J\,g^{-1}\,°C$ means that it takes 4.2 J of energy to vaporise 1.0 g of liquid water.

D There are more hydrogen bonds between water molecules in a gas than between water molecules in a liquid.

6. Nov/2023/Paper_ 9700/12/No.8

A student carried out the Benedict's test on four different concentrations of glucose solution and then recorded the time taken for the first appearance of a colour change (the end-point).

The student found it difficult to identify the first appearance of a colour change and consistently timed each solution for two seconds after the colour change first appeared. This introduced a source of error into the experiment.

Which statements about this error are correct?

1 The effect of the error will be reduced if the student performs three repeats at each concentration of glucose.

2 The error will prevent the student from identifying which solution has the highest concentration of glucose.

3 The error is systematic as the student consistently timed each solution for two seconds after the end-point.

A 1 and 2 **B** 1 and 3 **C** 2 and 3 **D** 3 only

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7. Nov/2023/Paper_ 9700/12/No.9

Which statements about amylopectin and glycogen are correct?

1 Amylopectin and glycogen contain 1-4 glycosidic bonds.

2 Amylopectin contains β-glucose.

3 Glycogen contains more 1-6 branches than amylopectin.

A 1 and 2 **B** 1 and 3 **C** 1 only **D** 2 and 3

8. Nov/2023/Paper_ 9700/12/No.10

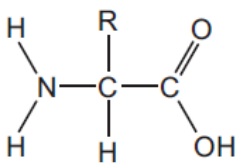
How many statements about fatty acids are correct?

- Fatty acids are either saturated or unsaturated.
- Fatty acids always have at least two double bonds.
- Long chains of fatty acids are very good energy stores.
- Fatty acids are insoluble in water and do not affect the water potential of the cell.

A 1 **B** 2 **C** 3 **D** 4

9. Nov/2023/Paper_ 9700/12/No.11

The diagram represents an amino acid.



R represents a variable side chain.

What is **not** a possible side chain?

A CH_3

B $CH_2CH_2SCH_3$

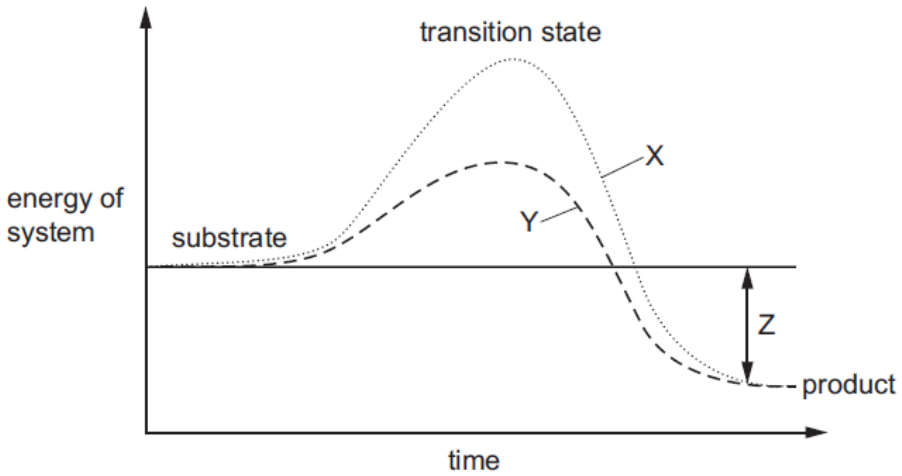
C CH_2CONH_2

D $HOCH_2CH(OH)CH_2OH$

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10. Nov/2023/Paper_ 9700/12/No.12

The graph shows the effect of an enzyme on a reaction.



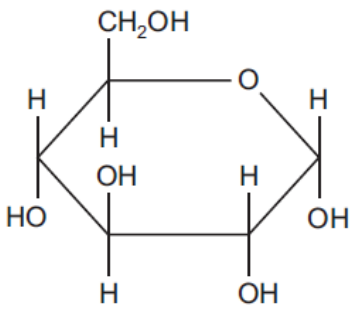
Which row identifies X, Y and Z?

	X	Y	Z
A	catalysed reaction	uncatalysed reaction	energy lost by product
B	catalysed reaction	uncatalysed reaction	overall energy lost during reaction
C	uncatalysed reaction	catalysed reaction	energy gained by product
D	uncatalysed reaction	catalysed reaction	overall energy released during reaction

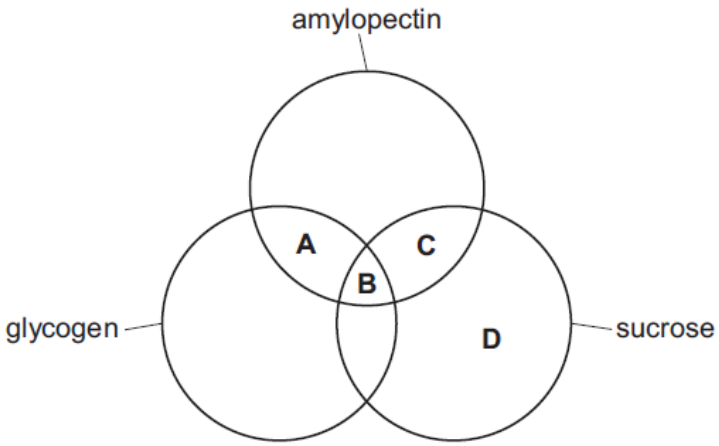
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11. Nov/2023/Paper_ 9700/13/No.9

The diagram shows the structure of a monomer.



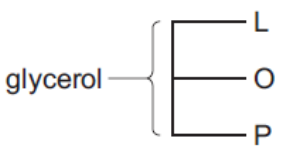
Which molecules contain this monomer?



12. Nov/2023/Paper_ 9700/13/No.10

A triglyceride consists of glycerol and three different fatty acids: linoleic acid (L), oleic acid (O) and palmitic acid (P).

The diagram shows one possible arrangement of the fatty acids L, O and P in the molecule.



What is the total number of different arrangements of the fatty acids in this triglyceride?

A 3 **B** 4 **C** 5 **D** 9

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13. Nov/2023/Paper_ 9700/13/No.11

Which statement about phospholipid molecules is correct?

A They contain one saturated fatty acid and two unsaturated fatty acids.

B They contain three phosphodiester bonds.

C They contain hydrophobic regions and hydrophilic regions.

D They contain a hydrophobic phosphate group that is soluble in water.

14. Nov/2023/Paper_ 9700/13/No.12

Hydrogen bonding explains many of the properties of water, including the high latent heat of vaporisation and high specific heat capacity.

For which processes in plants is hydrogen bonding in water important on hot sunny days?

1 preventing denaturation of enzymes in leaves

2 reducing water loss by evaporation

3 allowing leaves to cool down quickly at night

4 holding the column of water in xylem vessels together

A 1, 2, 3 and 4

B 1, 2 and 4 only

C 1, 3 and 4 only

D 2 and 3 only

15. Nov/2023/Paper_ 9700/13/No.13

Which feature of cellulose molecules contributes to the function of plant cell walls?

A Adjacent cellulose molecules are linked by glycosidic bonds.

B Branched chains of β-glucose molecules are linked by hydrogen bonds.

C Molecules of α-glucose are linked by 1-6 glycosidic bonds.

D Unbranched chains of β-glucose are linked by hydrogen bonds.

16. Nov/2023/Paper_ 9700/22/No.2

Keratin is the structural protein in feathers of birds. Keratin polypeptides are composed of a high proportion of cysteine amino acids, which have sulfur-containing R groups.

Keratin polypeptides form filaments. The two main types of keratin in feathers are α-keratin, which consists of many α-helices, and β-keratin, consisting of many β-pleated sheets.

(a) Keratin can be classified as α-keratin or β-keratin based on a study of protein structure.

Suggest the level of protein structure used to classify a protein as α-keratin or β-keratin.

..... [1]

(b) Protease enzymes hydrolyse proteins. Many proteases are able to hydrolyse more than one type of protein.

Suggest why it is possible for a protease to act on different types of protein.

.....

.....

..... [1]

(c) Proteases known as keratinases vary in the extent to which they can hydrolyse keratin.

Feathers are not easily degraded (broken down) because keratin is a very stable protein.

Suggest features of keratin structure that contribute to its stability.

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..... [3]

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Keratinases are used to degrade the large quantities of waste feathers from chickens and turkeys that are processed in the food industry. The products of feather degradation can be used in animal feed.

Scientists investigated whether three different keratinases, K12, A22 and P3, were suitable as industrial enzymes. These enzymes were extracted from three different soil bacteria.

The effects of temperature and pH on the activity of each keratinase were investigated.

The results are shown in Fig. 2.1 and Fig. 2.2.

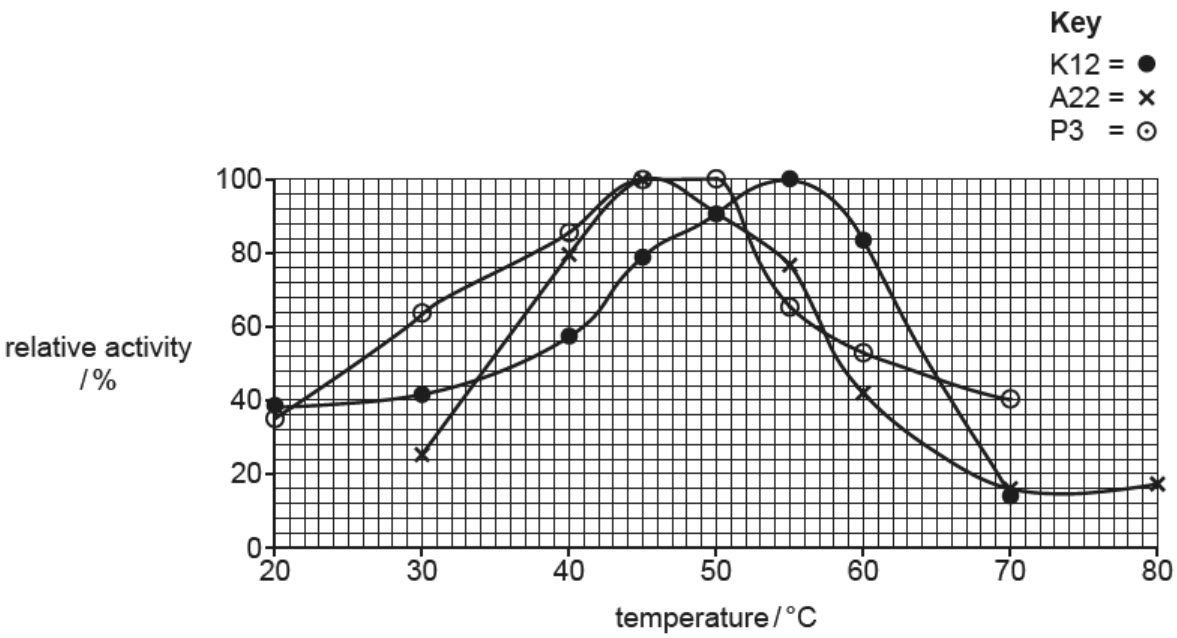


Fig. 2.1

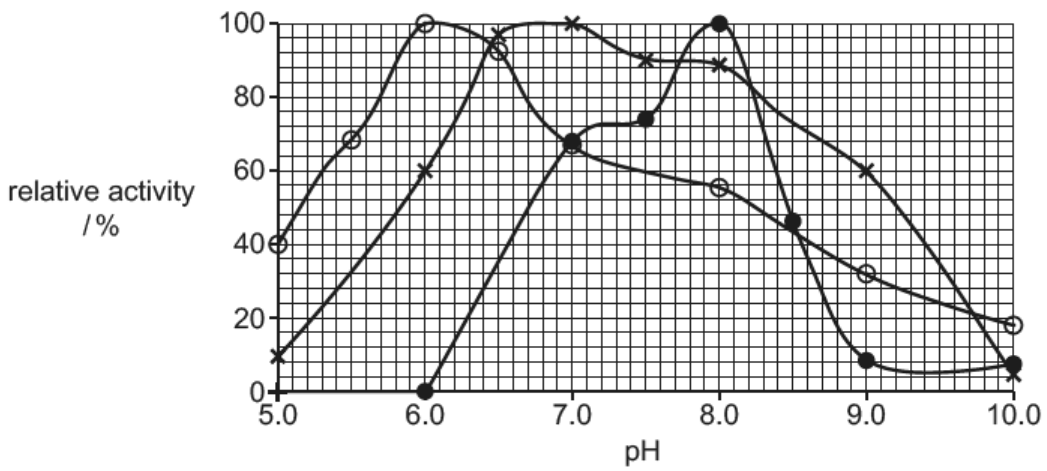


Fig. 2.2

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(d) To degrade feather waste from industry, it is an advantage to use keratinases that show at least 60% relative activity in conditions where temperature and pH can vary widely.

Table 2.1 shows, for each keratinase, the working range of temperature and pH where at least 60% relative activity is obtained.

Use Fig. 2.1 and Fig. 2.2 to complete Table 2.1 **and** use the completed table to:

- name the keratinase that has the widest working range of temperature
- name the keratinase that has the widest working range of pH.

Table 2.1

keratinase	temperature range with at least 60% relative activity / °C	pH range with at least 60% relative activity
K12	41–63	
A22		6.0–9.0
P3	29–56	5.3–7.5

Keratinase with a relative activity of at least 60% that has:

- the widest working range of temperature .....
- the widest working range of pH .....

[4]

(e) Some detergents contain proteases to remove stains from clothes. These enzymes have a high relative activity in alkaline conditions.

The scientists reported that K12 and A22 could be suitable for use in the detergent industry.

With reference to Fig. 2.1 and Fig. 2.2, discuss the advantages **and** disadvantages of using K12 and A22 in the detergent industry.

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..... [3]

[Total: 12]

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17. Nov/2023/Paper_ 9700/23/No.2

Glucose is used in the synthesis of amylose. Glucose is first converted to glucose 1-phosphate (G 1-P).

Starch phosphorylase is an intracellular enzyme that can catalyse the synthesis of amylose from G 1-P, which is the substrate for the reaction:

$$(\text{glucose 1-phosphate})n \longrightarrow \text{amylose} + (\text{phosphate ions})n$$

n = a large number

Students used a colorimeter to investigate the progress of the reaction.

The students made a reaction mixture containing 0.01 mol dm^{-3} G 1-P in a buffer solution at pH 6.0. A very small quantity of amylose was added to initiate the reaction.

A solution of starch phosphorylase was added to the reaction mixture and samples were taken at 1-minute intervals. Each sample was added to a dilute iodine solution, stirred and then poured into a cuvette. The absorbance of each solution was recorded.

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The results of the investigation are shown in Fig. 2.1.

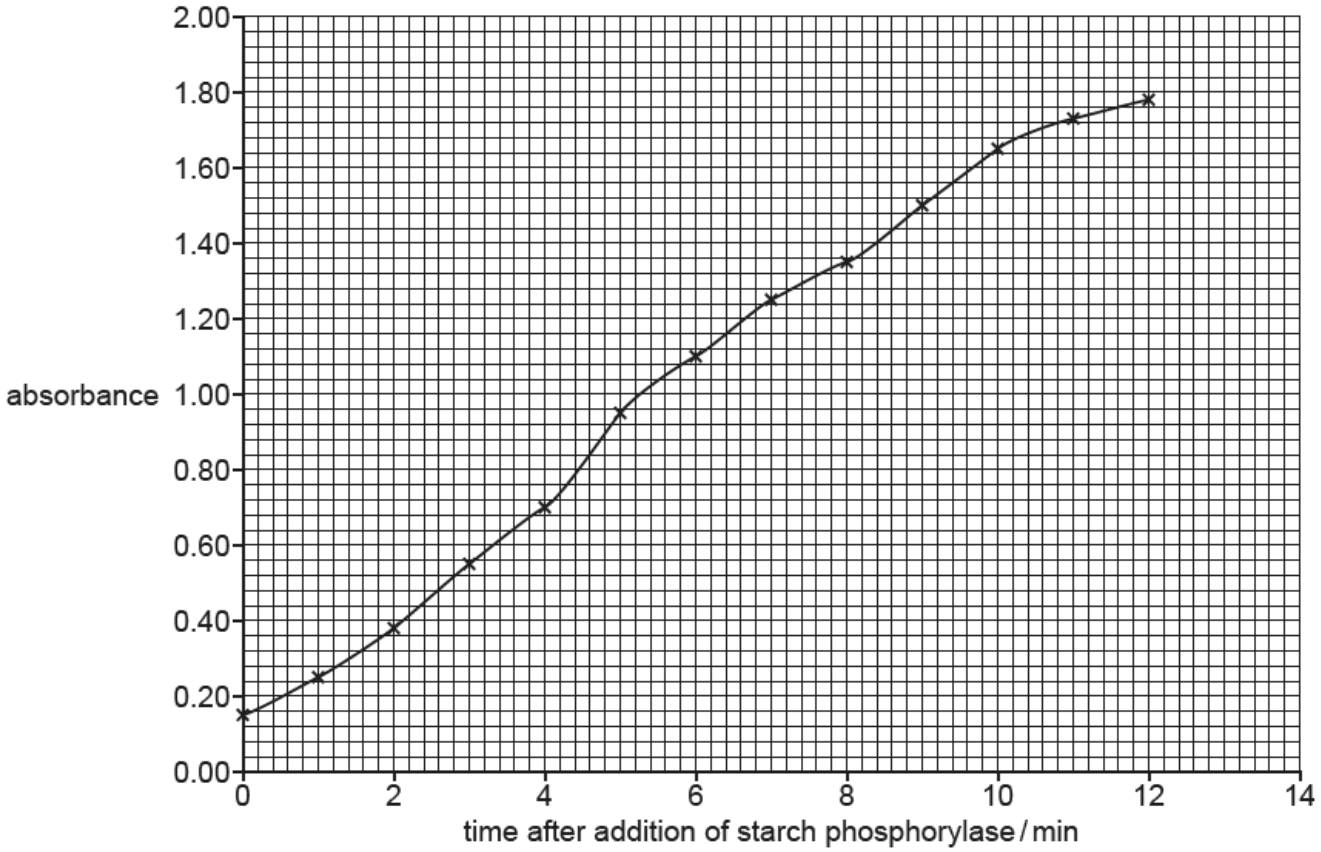


Fig. 2.1

(a) (i) Explain why the absorbance increases, as shown in Fig. 2.1.

.....

.....

..... [1]

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(ii) The students took their final sample at 12 minutes.

Predict the results for absorbance if the students had continued to take samples for a further 10 minutes. Explain your answer.

prediction .....

.....

.....

explanation .....

.....

.....

[2]

(iii) State an advantage of using a colorimeter in determining the progress of the reaction.

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.....

..... [1]

(b) The reaction catalysed by starch phosphorylase occurs at the ends of amylose molecules.

Describe the sequence of events that occurs when starch phosphorylase catalyses the addition of a molecule of glucose to the end of an amylose molecule.

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..... [4]

[Total: 8]

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18. Nov/2023/Paper_ 9700/23/No.3

Haemoglobin is a complex protein molecule made of four separate subunits, as shown in Fig. 3.1.

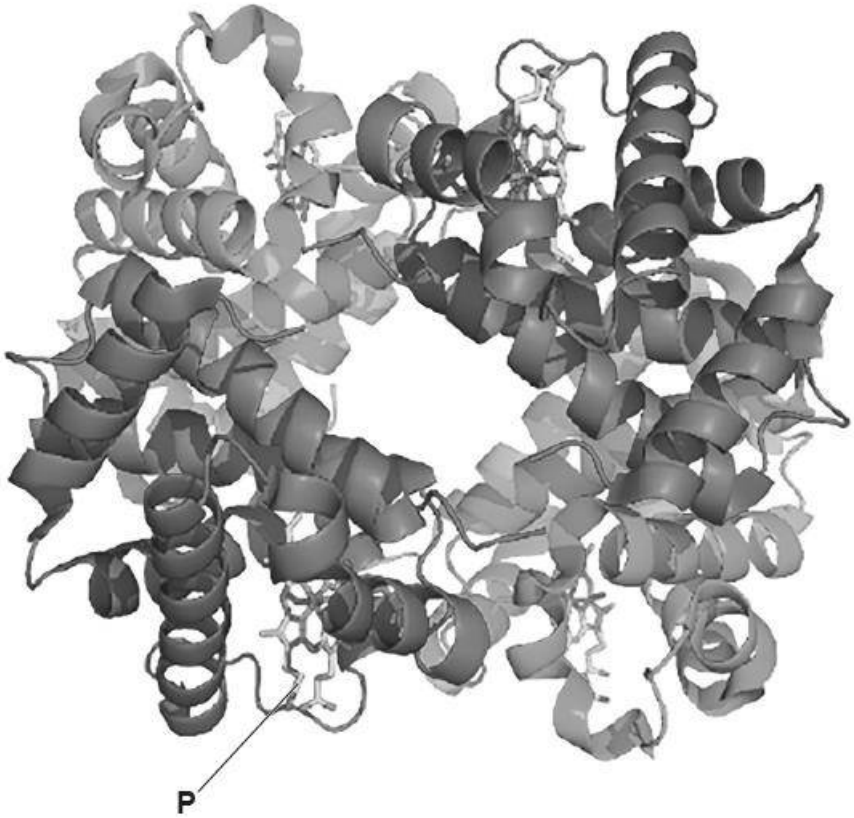


Fig. 3.1

(a) (i) The shading represents the two different polypeptides that form a molecule of haemoglobin.

State the names of the **two** different polypeptides.

.....

..... [1]

(ii) Identify the structure labelled **P** in Fig. 3.1.

..... [1]

(iii) Fig. 3.1 shows some of the levels of protein structure.

State the level of protein structure that is **not** shown in Fig. 3.1.

.....

..... [1]

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(b) Haemoglobin is involved in the transport of carbon dioxide.

Molecules of carbon dioxide enter red blood cells as the cells travel in capillaries through muscle tissue. Some of these molecules are converted to carbonic acid.

Explain how haemoglobin is involved in the transport of carbon dioxide molecules that are **not** converted to carbonic acid.

.....

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.....

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..... [3]

(c) When haemoglobin associates (binds) with oxygen it forms oxyhaemoglobin.

State the precise site in the mammalian body where haemoglobin molecules bind with oxygen.

.....

..... [1]

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(d) The compound 2,3-diphosphoglycerate (2,3-DPG) is produced in red blood cells. 2,3-DPG binds to haemoglobin and stabilises it.

Fig. 3.2 shows oxygen dissociation curves when red blood cells have high and low concentrations of 2,3-DPG.

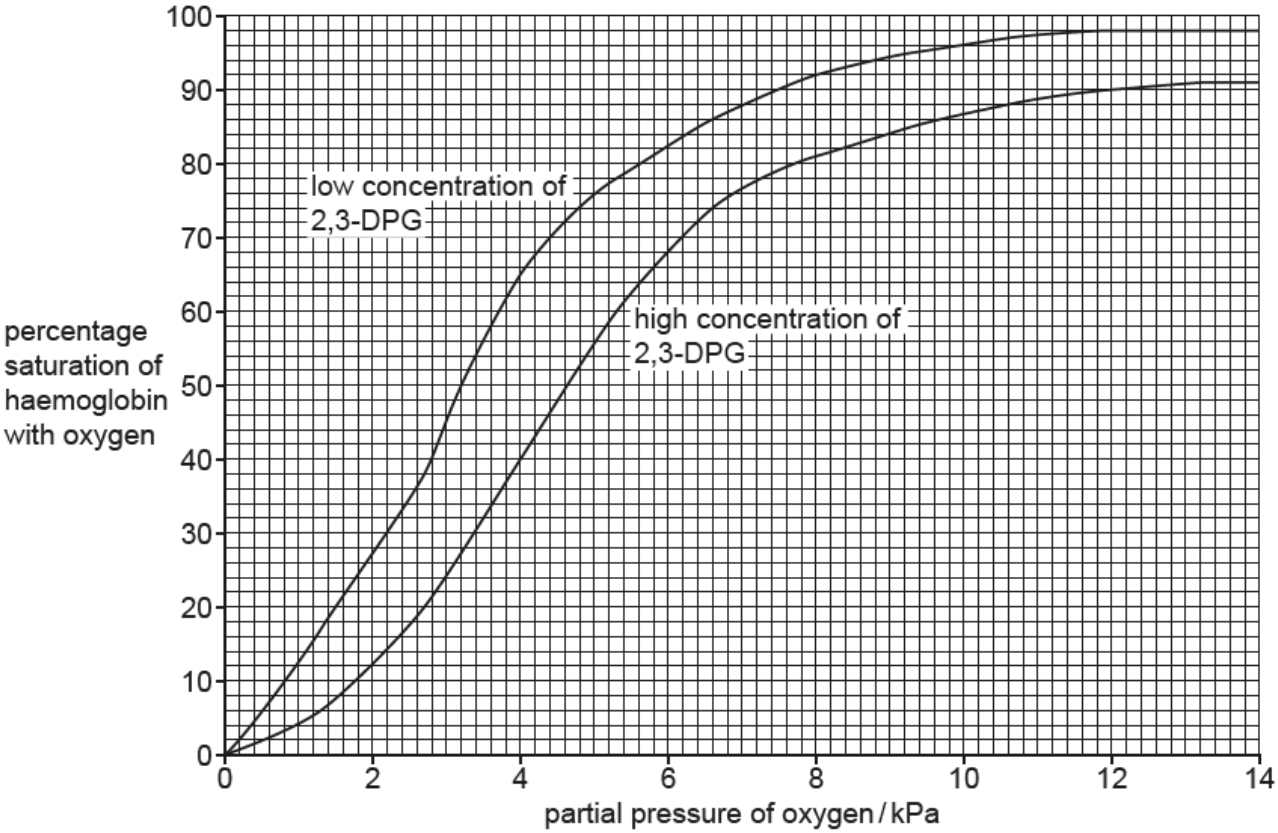


Fig. 3.2

P_{50} is the partial pressure of oxygen when haemoglobin is 50% saturated. The P_{50} is used to compare the affinity of haemoglobin for oxygen under different conditions.

(i) Use the information in Fig. 3.2 to describe the effect of an increase in the concentration of 2,3-DPG on the oxygen dissociation curve.

.....

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.....

..... [2]

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(ii) Blood is stored in blood banks for use in hospitals during operations.

The concentration of 2,3-DPG in red blood cells decreases when blood is stored in a blood bank.

State **and** explain the effect that the use of blood taken from a blood bank has on the supply of oxygen to the tissues of a person during an operation.

.....

.....

.....

.....

..... [2]

[Total: 11]

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