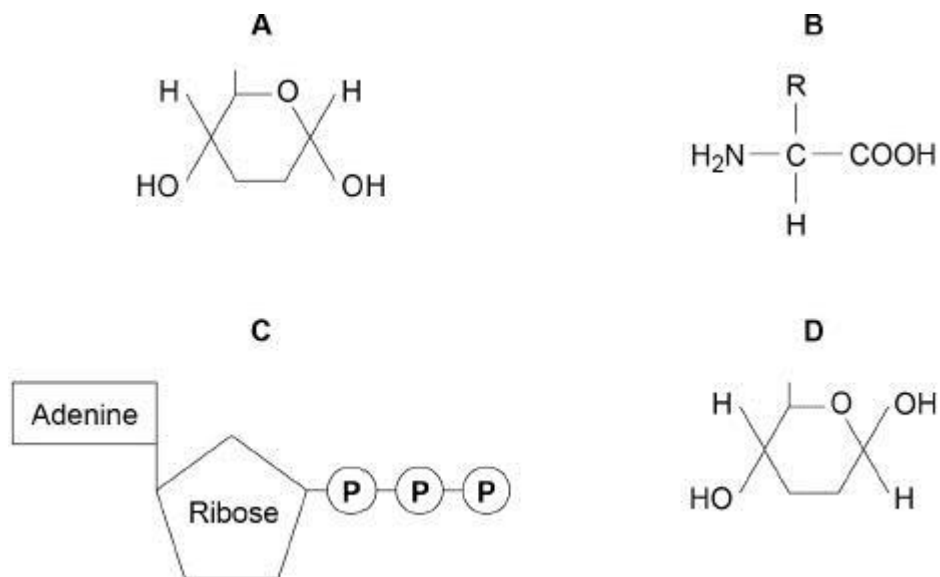


BIOLOGICAL MOLECULES

MONOMERS & POLYMERS EXAM Q&A

Q1.

The diagram below shows the structure of molecules found in organisms.



- (a) Complete the table below by putting the correct letter, **A**, **B**, **C** or **D**, in the box next to each statement. Each letter may be used once, more than once, or not at all.

Letter	Statement
	is a monomer in an enzyme's active site
	is a monomer in cellulose
	is produced during photosynthesis and respiration
	forms a polymer that gives a positive result with a biuret test

(4)

- (b) Raffinose is a trisaccharide of three monosaccharides: galactose, glucose and fructose. The chemical formulae of these monosaccharides are:

- galactose = $C_6H_{12}O_6$
- glucose = $C_6H_{12}O_6$
- fructose = $C_6H_{12}O_6$

Give the number of carbon atoms, hydrogen atoms and oxygen atoms in a molecule of raffinose.

Number of carbon atoms _____

An allergic reaction is caused by an immune response.

Draw a labelled diagram of an antibody **and** identify the specific alpha-gal binding site.

(3)

- (c) A tick is a small animal that bites humans and feeds on their blood. This results in proteins from the tick saliva entering the human body.

Scientists have suggested one hypothesis for the allergic reaction to alpha-gal in red meat. They think that an earlier immune response to a tick bite can cause a person to have an allergic reaction to alpha-gal in red meat.

Suggest how **one** antibody can be specific to tick protein and to alpha-gal.

(2)

- (d) Scientists took blood samples from one man over several weeks and measured the concentration of antibody in the man's blood. During this time, the man had two tick bites and had an allergic reaction to alpha-gal in red meat.

The scientists' results are shown in the graph below.

It regulates the timing of mitosis during the cell cycle. Mitosis starts when the concentration of Cyclin B in the nucleus rises sharply and ends when it falls. The scientists found that ABZ increased, and maintained, a high concentration of Cyclin B in stomach tumour cells.

Programmed cell death is called apoptosis. Two nuclear proteins, Bcl-2 and Bax, are involved in controlling apoptosis. Apoptosis is prevented when the ratio of Bcl-2 to Bax is high and is promoted when this ratio is low. The scientists found that ABZ decreased the concentration of Bcl-2 and increased the concentration of Bax in stomach tumour cells. 10

From their results the scientists claimed that ABZ could be used for the successful treatment of stomach cancer. 15

Use information from the passage and your own understanding to answer the questions.

- (a) Suggest why preventing the formation of spindle fibres (lines 2–3) stopped the cell cycle.

(2)

- (b) Suggest and explain why ABZ could be used as a treatment for cancer even though it affects some healthy cells (lines 3–4).

(1)

- (c) What can you conclude about the effect of ABZ on tumour cells?

Use information about changes in the concentrations of Cyclin B (lines 6–7), and Bcl-2 and Bax (lines 10–14).

(5)
(Total 15 marks)

Q5.

(a) What is a monomer?

(1)

(b) Lactulose is a disaccharide formed from one molecule of galactose and one molecule of fructose.

Other than both being disaccharides, give one similarity and one difference between the structures of lactulose and lactose.

Similarity _____

Difference _____

(2)
(Total 6 marks)

Q7.

Write an essay on the ways in which water and the regulation of water content are important to organisms.

(Total 25 marks)

Q8.

(a) Describe how you would test a piece of food for the presence of lipid.

(2)

The figure below shows a phospholipid.

(1)

Scientists investigated the percentages of different types of lipid in plasma membranes from different types of cell. The table shows some of their results.

Type of lipid	Percentage of lipid in plasma membrane by mass		
	Cell lining ileum of mammal	Red blood cell of mammal	The bacterium <i>Escherichia coli</i>
Cholesterol	17	23	0
Glycolipid	7	3	0
Phospholipid	54	60	70
Others	22	14	30

(e) The scientists expressed their results as **Percentage of lipid in plasma membrane by mass**. Explain how they would find these values.

(2)

Cholesterol increases the stability of plasma membranes. Cholesterol does this by making membranes less flexible.

(f) Suggest **one** advantage of the different percentage of cholesterol in red blood cells compared with cells lining the ileum.

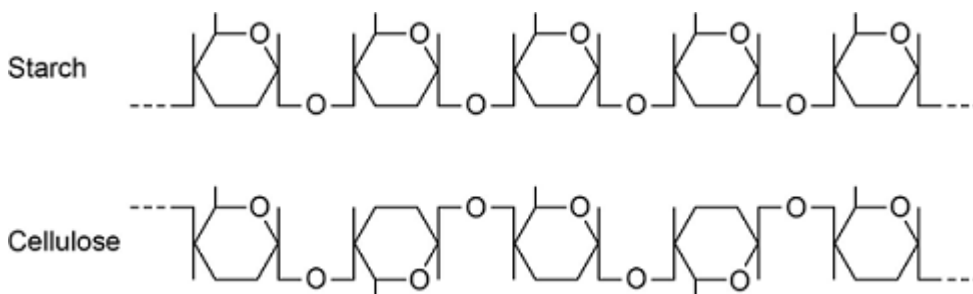
(1)

(g) *E. coli* has no cholesterol in its cell-surface membrane. Despite this, the cell maintains a constant shape. Explain why.

Q9.

Starch and cellulose are two important plant polysaccharides.

The following diagram shows part of a starch molecule and part of a cellulose molecule.



- (a) Explain the difference in the structure of the starch molecule and the cellulose molecule shown in the diagram above.

(2)

- (b) Starch molecules and cellulose molecules have different functions in plant cells. Each molecule is adapted for its function.

Explain **one** way in which starch molecules are adapted for their function in plant cells.

(2)

- (c) Explain how cellulose molecules are adapted for their function in plant cells.

(c) Describe how proteins are digested in the human gut.

(4)

(Total 15 marks)

Q11.

A student investigated the effect of chewing on the digestion of starch in cooked wheat.

He devised a laboratory model of starch digestion in the human gut. This is the method he used.

1. Volunteers chewed cooked wheat for a set time. The wheat had been cooked in boiling water.
2. This chewed wheat was mixed with water, hydrochloric acid and a protein-digesting enzyme and left at 37 °C for 30 minutes.
3. A buffer was then added to bring the pH to 6.0 and pancreatic amylase was added. This mixture was then left at 37 °C for 120 minutes.
4. Samples of the mixture were removed at 0, 10, 20, 40, 60 and 120 minutes, and the concentration of reducing sugar in each sample was measured.
5. Control experiments were carried out using cooked wheat that had been chopped up in a blender, not chewed.

(a) What reducing sugar, or sugars, would you expect to be produced during chewing? Give a reason for your answer.

(2)

(b) In this model of digestion in the human gut, what other enzyme is required for the complete digestion of starch?

(1)

(c) What was the purpose of step 2, in which samples were mixed with water,

hydrochloric acid and pepsin?

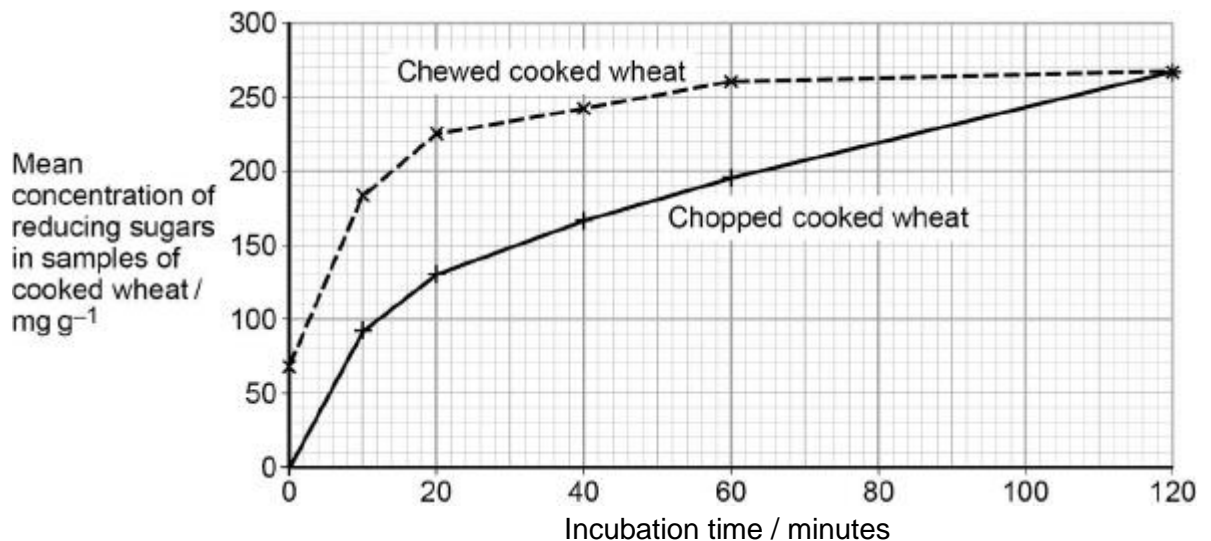
(1)

- (d) In the control experiments, cooked wheat was chopped up to copy the effect of chewing.

Suggest a more appropriate control experiment. Explain your suggestion.

(2)

- (e) The figure below shows the student's results.



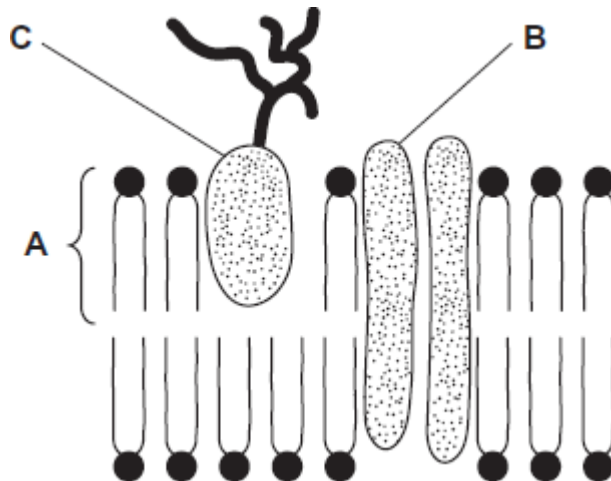
Explain what these results suggest about the effect of chewing on the digestion of starch in wheat.

(3)

(Total 9 marks)

Q12.

The diagram shows the structure of the cell-surface membrane of a cell.



(a) Name **A** and **B**.

A _____

B _____

(2)

(b) (i) **C** is a protein with a carbohydrate attached to it. This carbohydrate is formed by joining monosaccharides together. Name the type of reaction that joins monosaccharides together.

Name the type of reaction that joins monosaccharides together.

(1)

(ii) Some cells lining the bronchi of the lungs secrete large amounts of mucus. Mucus contains protein.

Name **one** organelle that you would expect to find in large numbers in a mucus-secreting cell and describe its role in the production of mucus.

Organelle _____

Description of role _____

(2)

(Total 5 marks)

Q13.

(a) Name the monosaccharides of which the following disaccharides are composed.

(i) Sucrose
 monosaccharides _____ and _____

(1)

(ii) Lactose
 monosaccharides _____ and _____

(1)

(b) Amylase and maltase are involved in the digestion of starch in the small intestine.

Complete the table by identifying where these enzymes are produced and the product of the reaction they catalyse.

Name of enzyme	Where the enzyme is produced	Product of the reaction catalysed by the enzyme
Amylase		
Maltase		

(2)

(Total 4 marks)

Q14.

(a) The table shows some statements about three carbohydrates. Complete the table with a tick in each box if the statement is true.

Statement	Starch	Cellulose	Glycogen
Found in plant cells			
Contains glycosidic bonds			
Contains β -glucose			

(3)

(b) Name the type of reaction that would break down these carbohydrates into their monomers.

(1)

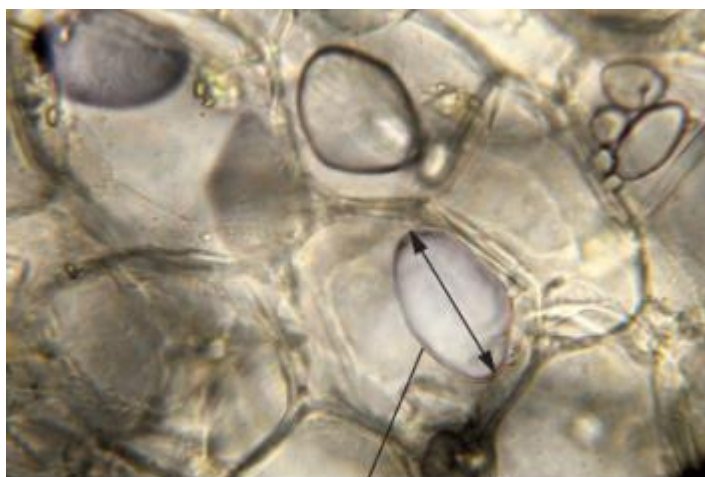
(c) Give **one** feature of starch and explain how this feature enables it to act as a storage substance.

Feature _____

Explanation _____

(2)

- (d) The picture shows starch grains as seen with an optical microscope. The actual length of starch grain **A** is 48 μm . Use this information and the arrow line to calculate the magnification of the picture. Show your working.



Starch grain A

© iStock/Thinkstock

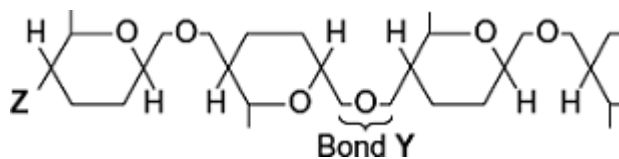
Magnification _____ times

(2)

(Total 8 marks)

Q15.

The diagram shows one end of a cellulose molecule.



- (a) (i) Name the monomers that form a cellulose molecule.

(1)

- (ii) Name bond Y.

(1)

- (iii) What chemical group is at position **Z**?

(1)

- (b) (i) Complete the table to show **two** ways in which the structure of cellulose is different from the structure of starch.

Starch	Cellulose

(2)

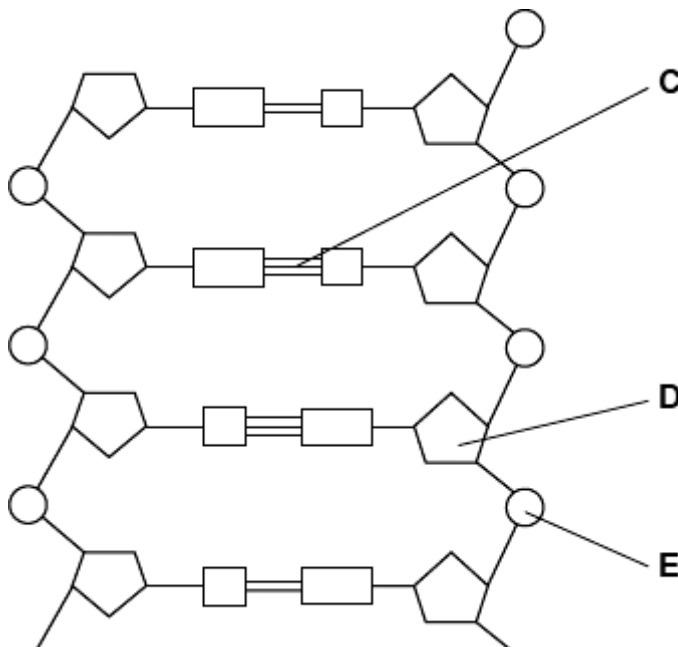
- (ii) Explain **one** way in which the structure of cellulose is linked to its function.

(2)

(Total 7 marks)

Q16.

The diagram shows part of a DNA molecule.



- (a) (i) DNA is a polymer. What is the evidence from the diagram that DNA is a polymer?

(1)

(ii) Name the parts of the diagram labelled **C**, **D** and **E**.

Part **C** _____

Part **D** _____

Part **E** _____

(3)

(iii) In a piece of DNA, 34% of the bases were thymine.

Complete the table to show the names and percentages of the other bases.

Name of base	Percentage
Thymine	34
	34

(2)

(b) A polypeptide has 51 amino acids in its primary structure.

(i) What is the minimum number of DNA bases required to code for the amino acids in this polypeptide?

(1)

(ii) The gene for this polypeptide contains more than this number of bases.

Explain why

(1)

(Total 8 marks)

Q17.

Read the following passage.

Aspirin is a very useful drug. One of its uses is to reduce fever and inflammation. Aspirin does this by preventing cells from producing substances called prostaglandins. Prostaglandins are produced by an enzyme-controlled pathway. Aspirin works by inhibiting one of the enzymes in this pathway. Aspirin attaches permanently to a chemical group on one of the monomers that make up the active site of this enzyme. 5

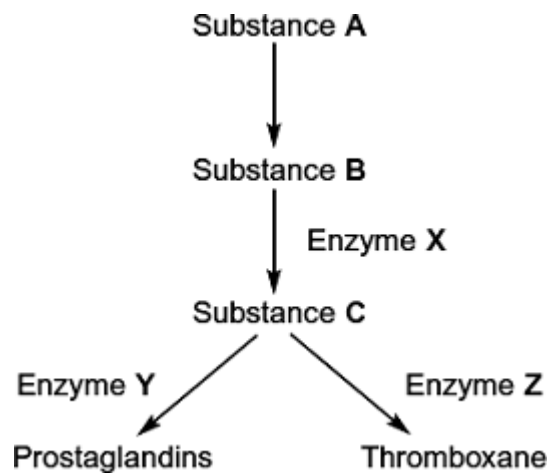
The enzyme that is involved in the pathway leading to the production of prostaglandins is also involved in the pathway leading to the production of thromboxane. This is a substance that promotes blood clotting. A small daily dose of aspirin may reduce the risk of myocardial infarction (heart attack). 10

Use information from the passage and your own knowledge to answer the following questions.

- (a) Name the monomers that make up the active site of the enzyme (lines 6 – 7).

(1)

- (b) The diagram shows the pathways by which prostaglandins and thromboxane are formed.



- (i) Aspirin only affects one of the enzymes in this pathway. Use information in lines 5 - 7 to explain why aspirin does **not** affect the other enzymes.

(2)

- (ii) Which enzyme, **X**, **Y** or **Z**, is inhibited by aspirin? Explain the evidence from the passage that supports your answer.

Enzyme _____

Explanation _____

(2)

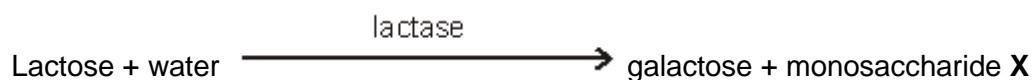
- (c) Aspirin is an enzyme inhibitor. Explain how aspirin prevents substrate molecules being converted to product molecules.

(2)

(Total 7 marks)

Q18.

The equation shows the breakdown of lactose by the enzyme lactase.



- (a) (i) Name the type of reaction catalysed by the enzyme lactase.

(1)

- (ii) Name monosaccharide X.

(1)

- (b) (i) Describe how you would use a biochemical test to show that a reducing sugar is present.

(2)

- (ii) Lactose, galactose and monosaccharide X are all reducing sugars. After the lactose has been broken down there is a higher concentration of

reducing sugar. Explain why.

(1)

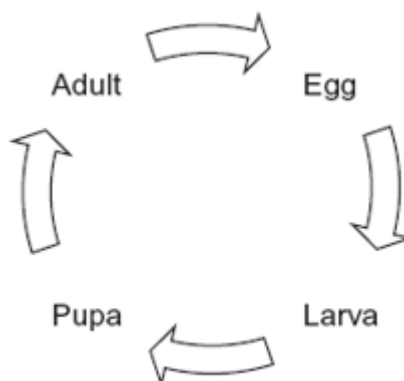
- (c) A high concentration of galactose slows down the breakdown of lactose by lactase. Use your knowledge of competitive inhibition to suggest why.

(2)

(Total 7 marks)

Q19.

The diagram shows the life cycle of a fly.



When the larva is fully grown, it changes into a pupa. The pupa does not feed. In the pupa, the tissues that made up the body of the larva are broken down. New adult tissues are formed from substances obtained from these broken-down tissues and from substances that were stored in the body of the larva.

- (a) Hydrolysis and condensation are important in the formation of new adult proteins. Explain how.

(2)

- (b) Most of the protein stored in the body of a fly larva is a protein called calliphorin.

Explain why different adult proteins can be made using calliphorin.

(1)

The table shows the mean concentration of RNA in fly pupae at different ages.

Age of pupa as percentage of total time spent as a pupa	Mean concentration of RNA / μg per pupa
0	20
20	15
40	12
60	17
80	33
100	20

(c) Describe how the concentration of RNA changes during the time spent as a pupa.

(2)

(d) (i) Describe how you would expect the number of lysosomes in a pupa to change with the age of the pupa. Give a reason for your answer.

(2)

(ii) Suggest an explanation for the change in RNA concentration in the first 40% of the time spent as a pupa.

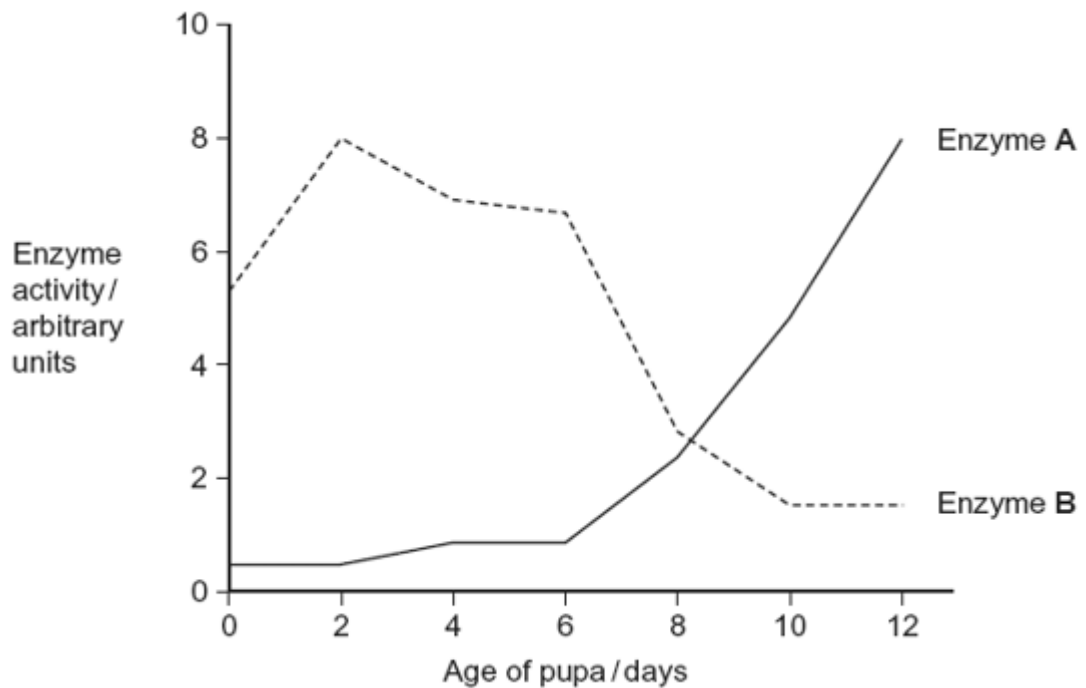
(2)

(e) Suggest an explanation for the change in RNA concentration between 60 and 80% of the time spent as a pupa.

(2)

(f) The graph shows changes in the activity of two respiratory enzymes in a fly pupa.

- Enzyme **A** catalyses a reaction in the Krebs cycle
- Enzyme **B** catalyses the formation of lactate from pyruvate



During the first 6 days as a pupa, the tracheae break down. New tracheae are formed after 6 days. Use this information to explain the change in activity of the two enzymes.

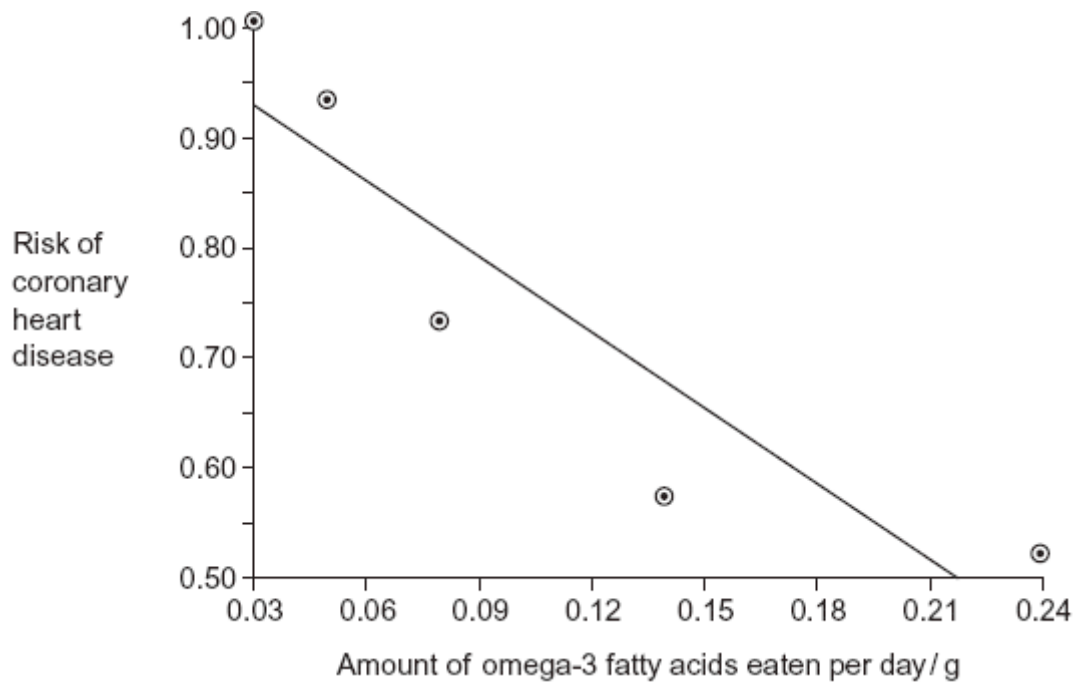
(4)
(Total 15 marks)

Q20.

(a) Omega-3 fatty acids are unsaturated. What is an unsaturated fatty acid?

(2)

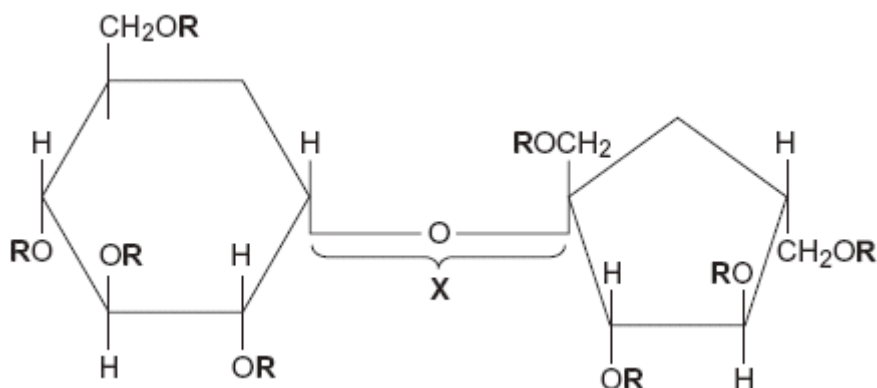
(b) Scientists investigated the relationship between the amount of omega-3 fatty acids eaten per day and the risk of coronary heart disease. The graph shows their results.



Do the data show that eating omega-3 fatty acids prevents coronary heart disease? Explain your answer.

(3)

- (c) Olestra is an artificial lipid. It is made by attaching fatty acids, by condensation, to a sucrose molecule. The diagram shows the structure of olestra. The letter **R** shows where a fatty acid molecule has attached.



- (i) Name bond **X**.

(1)

- (ii) A triglyceride does **not** contain sucrose or bond **X**. Give **one** other way in which the structure of a triglyceride is different to olestra.

(1)

- (iii) Starting with separate molecules of glucose, fructose and fatty acids, how many molecules of water would be produced when one molecule of olestra is formed?

(1)

(Total 8 marks)

Q21.

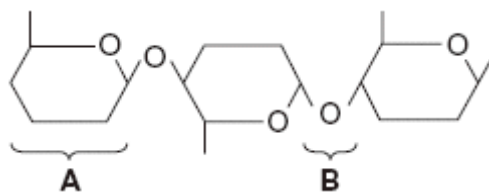
- (a) Give **one** feature of starch and explain how this feature enables it to act as a storage substance.

Feature _____

Explanation _____

(2)

(b) The diagram shows part of a cellulose molecule.



(i) Name part **A**.

(1)

(ii) Name bond **B**.

(1)

(c) The structure of cellulose is related to its role in plant cell walls. Explain how.

(3)

(Total 7 marks)

Q22.

(a) (i) The equation shows the reaction catalysed by the enzyme lactase. Complete this equation.



(2)

(ii) Name the type of chemical reaction shown in this equation.

(1)

(b) Lactase is an enzyme. Lactose is a reducing sugar.

(i) Describe how you could use the biuret test to distinguish a solution of the enzyme, lactase from a solution of lactose.

_____ (1)

(ii) Explain the result you would expect with the enzyme.

(1)

(Total 5 marks)

Q23.

(a) Sucrose, maltose and lactose are disaccharides.

(i) Sucrase is an enzyme. It hydrolyses sucrose during digestion. Name the products of this reaction.

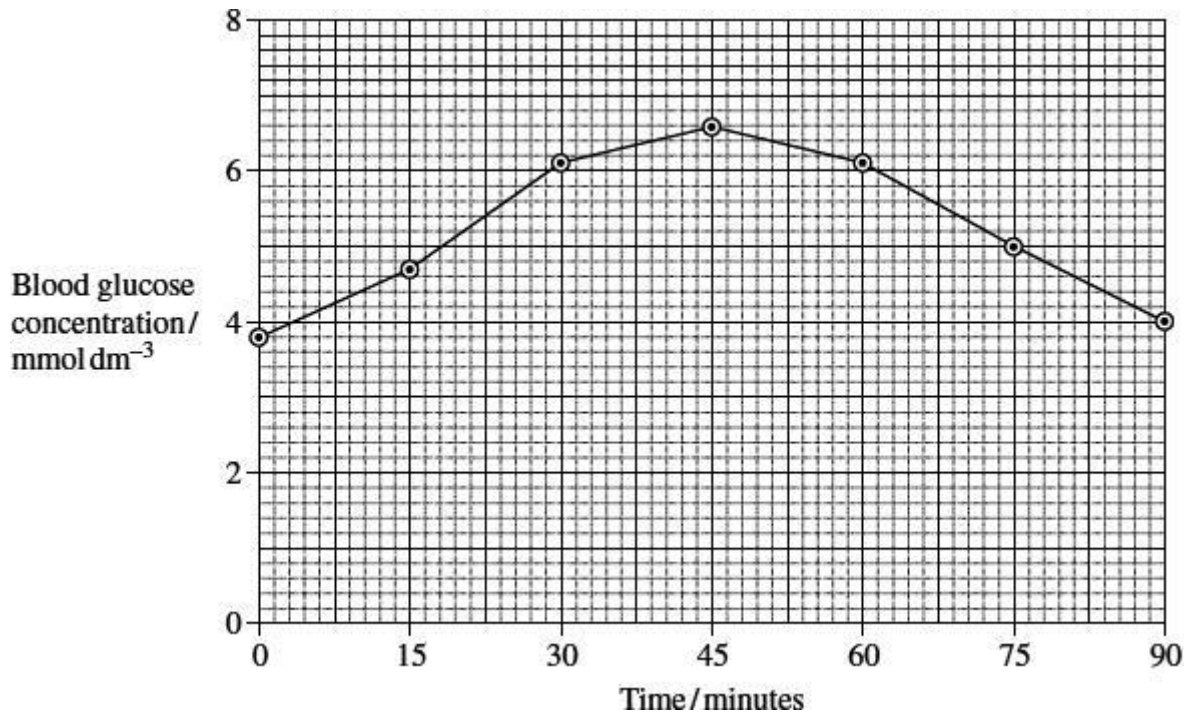
_____ and _____

(2)

(ii) Sucrase does **not** hydrolyse lactose. Use your knowledge of the way in which enzymes work to explain why.

(2)

(b) A woman was given a solution of sucrose to drink. Her blood glucose concentration was measured over the next 90 minutes. The results are shown on the graph.



- (i) Describe how the woman's blood glucose concentration changed in the period shown in the graph.

(2)

- (ii) Explain the results shown on the graph.

(2)

(Total 8 marks)

Q24.

Polymers have different structures. They also have different functions. Write an essay to describe how the structures of different polymers are related to their functions.

(Total 25 marks)

Q25.

Read the following passage.

Straw consists of three main organic substances – cellulose, hemicellulose and lignin. Cellulose molecules form chains which pack together into fibres. Hemicellulose is a small molecule formed mainly from five-carbon (pentose) sugar monomers. It acts as a cement holding cellulose fibres together. Like hemicellulose, lignin is a polymer, but it is not a carbohydrate. It covers the cellulose in the cell wall and supplies additional strength. In addition to these three substances, there are small amounts of other biologically important polymers present.

The other main component of straw is water. Water content is variable but may be determined by heating a known mass of straw at between 80 and 90°C until it reaches a constant mass. The loss in mass is the water content.

Since straw is plentiful, it is possible that it could be used for the production of a range of organic substances. The first step is the conversion of cellulose to glucose. It has been suggested that an enzyme could be used for this process. There is a difficulty here, however. The lignin which covers the cellulose protects the cellulose from enzyme attack.

Use information from the passage and your own knowledge to answer the following questions.

- (a) (i) Give **one** way in which the structure of a hemicellulose molecule is similar to the structure of a cellulose molecule.

(1)

- (ii) Complete the table to show **two** ways in which the structure of a hemicellulose molecule differs from the structure of a cellulose molecule.

Hemicellulose	Cellulose
<hr/> <hr/>	<hr/> <hr/>
<hr/> <hr/>	<hr/> <hr/>

(2)

- (b) Name **one** biologically important polymer, other than those mentioned in the passage, which would be found in straw.

(1)

- (c) Explain why the following steps were necessary in finding the water content of straw:

- (i) heating the straw *until it reaches constant mass* (line 9);

(1)

- (ii) not heating the straw above 90°C (line 9).

(2)

- (d) A covering of lignin protects cellulose from enzyme attack (line 14). Use your knowledge of the way in which enzymes work to explain why cellulose-digesting enzymes do not digest lignin.

(1)

- (b) In an investigation, the enzyme amylase was mixed in a test tube with a buffer solution and a suspension of starch. The amylase broke down the starch to maltose. When all the starch had been broken down, a sample was removed from the test tube and tested with biuret reagent.

- (i) Explain why a buffer solution was added to the amylase-starch mixture.

(2)

- (ii) What colour would you expect the sample to go when tested with biuret reagent?

(1)

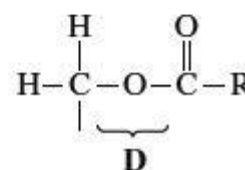
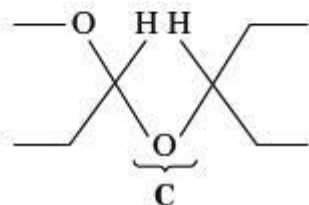
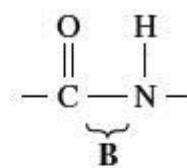
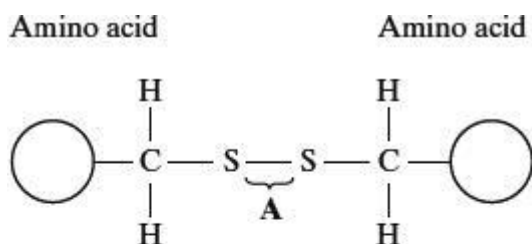
- (iii) Give an explanation for your answer to part (ii)

(2)

(Total 7 marks)

Q27.

The diagrams show four types of linkage, **A** to **D**, which occur in biological molecules.



- (a) Name the chemical process involved in the formation of linkage **B**.

(1)

(b) Give the letter of the linkage which

(i) occurs in a triglyceride molecule;

(1)

(ii) might be broken down by the enzyme amylase;

(1)

(iii) may occur in the tertiary, but not the primary structure of protein.

(1)

(c) Describe how a saturated fatty acid differs in molecular structure from an unsaturated fatty acid.

(2)

(Total 6 marks)

Mark schemes

Q1.

(a)

Letter	Statement
B;	is a monomer in an enzyme's active site
D;	is a monomer in cellulose
C;	is produced during photosynthesis and respiration
B;	forms a polymer that gives a positive result with a biuret test

Must be in correct order

4

(b) C = 18, H = 32, O = 16;

Accept only these answers

1

(c) 1. Heat with acid **and** neutralise;

Accept boil/water bath for heat

Accept named alkali for neutralise

Accept named examples, eg HCl, NaHCO₃

2. Heat with Benedict's (solution);

3. Red precipitate/colour;

Accept other colours eg orange/ brown/green

3

[8]

Q2.

(a) 1. C₁₂H₂₂O₁₁;

2. Condensation reaction

OR

With a glycosidic bond;

Reject if any other named reaction or named bond given.

Reject if reaction includes addition of water.

Do not credit answers relating to other carbohydrates.

2

(b) 1. Y shape showing two long and two short (polypeptide) chains correctly positioned;

Drawing is nothing like an antibody = 0 marks.

2. (Alpha-gal) binding site labelled on the end of the branches of the Y of the antibody;
Accept one or two being labelled, if two both must be correct.
3. Variable region labelled

OR

Constant region labelled

OR

Disulfide bridge/bond labelled;
*Accept description of 'variable region'.
Ignore labelling of light and heavy chains.
List rule applies.*

3

- (c)
1. (Part of tick protein and alpha-gal) have a similar shape/structure;
*Accept '(Part of tick protein and alpha-gal) have the same shape/structure.'
Do not credit reference to similar/same **tertiary** structure'.
Ignore reference to alpha-gal being a protein.*
 2. Antibody is complementary to both (tick protein and alpha-gal)

OR

Antigen-binding site is complementary to both (tick protein and alpha-gal)

OR

Antibody can form antigen-antibody complex with both (tick protein and alpha-gal);
Reject reference to substrates or active sites.

2

- (d)
1. Exposure to tick (protein) is followed by increase in antibody (specific to alpha-gal);
For 'is followed by' accept 'causes'.
 2. (Later) greater/faster increase in antibody suggests there are memory cells;
Must be in relation to EITHER second exposure to tick (protein) OR to allergic reaction.
 3. Antibody (specific to alpha-gal) increases during/after allergic reaction;
Accept 'eating red meat' or 'eating/exposure to alpha-gal' for 'allergic reaction'.
 4. During/after allergic reaction, total antibody increases more than alpha-gal antibody;
Accept 'eating red meat' or 'eating/exposure to alpha-gal' for 'allergic reaction'.
 5. (So) may be other antibodies (that are causing allergic reaction);

3 max

Q3.

(a)

Mark in pairs as (1 and 2 OR 3 and 4)

1. Chromosomes/centromeres cannot attach (to spindle)

OR

Chromosomes cannot line up (on spindle);

2. (So, no) metaphase;

OR

3. Chromatids cannot separate (on spindle);

*Accept description of 'cannot separate' e.g cannot move to poles
Ignore 'split'*

4. (So, no) anaphase;

2

- (b) 1. Cancer cells divide more/uncontrollably/rapidly

OR

Healthy cells divide less/slowly;

1

(c)

Ignore references to spindle fibres

1. (ABZ) increases/maintains Cyclin B;
2. (So) mitosis (starts but) does not end (no tumour growth);
*Ignore mitosis will continue
Ignore mitosis stops without qualification.*

3. (ABZ) lowers ratio of Bcl-2 to Bax;
*Accept (ABZ) decreases Bcl-2 **and** increases Bax*

4. (So) apoptosis occurs/cells die (no tumour growth);

4

(d) **In support of suggestion**

1. Stops mitosis (at metaphase/anaphase)/cell division (so no tumour growth)

OR

Promotes apoptosis/programmed cell death (so tumour destroyed);

Against suggestion

2. Healthy cells (are) damaged/affected
OR
Causes side effects;
3. Results from laboratory tests/tests on (isolated) cells

OR

No clinical trials/tests on patients/people;

4. Dosage unknown;

5. Effectiveness unknown;

2 max for points "Against suggestion"

3 max

[10]

Q4.

- (a)
1. A metabolite **in** condensation/hydrolysis/ photosynthesis/respiration;
 2. A solvent **so** (metabolic) reactions can occur
OR
A solvent **so** allowing transport of substances;
 3. High heat capacity **so** buffers changes in temperature;
For 'buffer' accept 'resist'.
 4. Large latent heat of vaporisation **so** provides a cooling effect (through evaporation);
 5. Cohesion (between water molecules) **so** supports columns of water (in plants);
*For 'columns of water' accept 'transpiration stream'.
Do not credit 'transpiration' alone but accept description of 'stream'.
For 'columns of water' accept 'cohesion-tension (theory)'.
For cohesion accept hydrogen bonding*
 6. Cohesion (between water molecules) **so** produces surface tension supporting (small) organisms;
For cohesion accept hydrogen bonding

*Ignore reference to pH.
Allow other suitable properties but must have a valid explanation.
For example*
 - *ice floating so maintaining aquatic habitat beneath*
 - *water transparent so allowing light penetration for photosynthesis*

5 max

(b)

4 max if marks gained from only 2 substance tests.

Lipid

1. Add ethanol/alcohol **then** add water **and** shake/mix
OR
Add ethanol/alcohol **and** shake/mix **then** pour into/add water;
*Reject heating emulsion test.
Accept 'Add Sudan III and mix'.*
2. White/milky emulsion
OR

emulsion test turns white/milky;

Ignore cloudy.

Reject precipitate.

Accept (for Sudan III) top (layer) red.

Non-reducing sugar

3. Do Benedict's test **and** stays blue/negative;
Ignore details of method for Benedict's test for this mp.
4. Boil with acid **then** neutralise with alkali;
Accept named examples of acids/alkalis.
5. Heat with Benedict's **and** becomes red/orange (precipitate);
Do not credit mp5 if no attempt at mp4.
For 'heat' ignore 'warm'/'heat gently'/'put in a water bath' but accept stated temperatures $\geq 60^{\circ}\text{C}$.
Heat must be stated again, do not accept using residual heat from mp4.
*Accept 'do the Benedict's test' **if** full correct method given elsewhere.*
Accept 'sodium carbonate, sodium citrate and copper sulfate solution' for Benedict's but must have all three if term 'Benedict's' not used.

Amylase

6. Add biuret (reagent) **and** becomes purple/violet/mauve/lilac;
Accept 'sodium or potassium hydroxide and copper sulfate solution' for 'biuret'.
Reject heating biuret test.
7. Add starch, (leave for a time), test for reducing sugar/absence of starch;

5 max

(c)

Ignore reference to dimers.

1. A condensation reaction joins monomers together **and** forms a (chemical) bond **and** releases water;
2. A hydrolysis reaction breaks a (chemical) bond between monomers **and** uses water;
3. A suitable example of polymers and the monomers from which they are made;
 3. and 4. *Polymers must contain many monomers.*
 3. and 4: *suitable examples include*
 - *amino acid **and** polypeptide, protein, enzyme, antibody or specific example*
 - *nucleotide **and** polynucleotide, DNA or RNA*
 - *Alpha glucose **and** starch/glycogen*

- Beta glucose **and** cellulose.

If neither specific carbohydrate example is given, allow monosaccharide/glucose and polysaccharide.

3. and 4. Reject (once) reference to triglycerides.

4. A second suitable example of polymers and the monomers from which they are made;

5. Reference to a correct bond within a named polymer;

Reject reference to ester bond.

5

[15]

Q5.

(a) (a monomer is a smaller / repeating) unit / molecule from which larger molecules / polymers are made;

Reject atoms / elements / 'building blocks' for units / molecules

Ignore examples

1

(b) **Similarity**

1. Both contain galactose / a glycosidic bond;

Ignore references to hydrolysis and / or condensation

Difference

2. Lactulose contains fructose, whereas lactose contains glucose;

Ignore alpha / beta prefix for glucose

Difference must be stated, not implied

2

(c) 1. (Lactulose) lowers the water potential of faeces / intestine / contents of the intestine;

Accept Ψ for water potential

2. Water retained / enters (due to osmosis) **and** softens the faeces;

Accept descriptions of soft faeces, eg faeces is less dry / less hard

2

(d) (-) 84.1(%);;

Accept (-) 84.15(%)

Allow 1 mark for

84

OR

$$\frac{2.82 \times 10^{-7} - 4.47 \times 10^{-8}}{2.82 \times 10^{-7}}$$

OR

$$\frac{2.37 \times 10^{-7}}{2.82 \times 10^{-7}}$$

2

[7]

Q6.

- (a) 1. Condensation (reaction) / loss of water;
Accept each marking point if shown clearly in diagram.
2. Between amine / NH₂ and carboxyl / COOH;
Accept between amino (group) and carboxylic / acid (group)
- (b) 1. Hydrogen bonds;
Accept as a diagram
Reject N - - - C / ionic / disulfide bridge / peptide bond
2. Between NH (group of one amino acid) and C=O (group);
OR
Forming β pleated sheets / α helix;
- (c) 1. Different sequence of amino acids
OR
Different primary structure;
If candidate assumes proteins are the same, accept effect of different pH/ temperature
2. Forms ionic / hydrogen / disulfide bonds in different places;

2

2

2

[6]

Q7.

21–25	Extended Abstract Generalised beyond specific context	Response shows holistic approach to the question with a fully integrated answer which makes clear links between several different topics and the theme of the question. Biology is detailed and comprehensive A-level content, uses appropriate terminology, and is very well written and always clearly explained. No significant errors or irrelevant material. For top marks in the band, the answer shows evidence of reading beyond specification requirements.
16–20	Relational Integrated into a whole	Response links several topics to the main theme of the question, to form a series of interrelated points which are clearly explained. Biology is fundamentally correct A-level content and contains some points which are detailed, though there may be some which are less well developed, with appropriate use of terminology. Perhaps one significant error and, or, one irrelevant topic which detracts from the overall quality of the answer.

11–15	Multistructural Several aspects covered but they are unrelated	Response mostly deals with suitable topics but they are not interrelated and links are not made to the theme of the question. Biology is usually correct A-level content, though it lacks detail. It is usually clearly explained and generally uses appropriate terminology. Some significant errors and, or, more than one irrelevant topic.
6–10	Unistructural Only one or few aspects covered	Response predominantly deals with only one or two topics that relate to the question. Biology presented shows some superficial A-level content that may be poorly explained, lacking in detail, or show limited use of appropriate terminology. May contain a number of significant errors and, or, irrelevant topics.
1–5	Unfocused	Response only indirectly addresses the theme of the question and merely presents a series of biological facts which are usually descriptive in nature or poorly explained and at times may be factually incorrect. Content and terminology is generally below A-level. May contain a large number of errors and, or, irrelevant topics.
0		Nothing of relevance or no response.

Commentary on terms and statements in the levels mark scheme

The levels mark scheme for the essay contains a number of words and statements that are open to different interpretations. This commentary defines the meanings of these words and statements in the context of marking the essay. Many words and statements are used in the descriptions of more than one level of response. The definitions of these remain the same throughout.

Levels mark scheme word/statement	Definition
Holistic	Synoptic, drawing from different topics (usually sections of the specification)
A fully integrated answer which makes clear links between several different topics and the theme of the question	All topics relate to the title and theme of the essay; for example, explaining the biological importance of a process. When considering, for example, the importance of a process, the explanation must be at A-level standard. 'Several' here is defined as at least four topic areas from the specification

	covered. This means some sentences, not just a word or two. It does not mean using many examples from one topic area.
Biology is detailed and comprehensive A-level content, uses appropriate terminology, and is very well written and always clearly explained.	Detailed and comprehensive A-level content is the specification content. Terminology is that used in the specification. Well written and clearly explained refers mainly to biological content and use of terminology. Prose, handwriting and spelling are secondary considerations. Phonetic spelling is accepted, unless examiners are instructed not to do so for particular words; for example, glucagon, glucose and glycogen.
No significant errors or irrelevant material.	A significant error is one which significantly detracts from the biological accuracy or correctness of a described example. This will usually involve more than one word. Irrelevant material is several lines (or more) that clearly fails to address the title, or the theme of the title.
For top marks in the band, the answer shows evidence of reading beyond specification requirements.	An example that is relevant to the title and is not required in the specification content. The example must be used at A-level standard.
Response mostly deals with suitable topics but they are not interrelated and links are not made to the theme of the question.	Not addressing the biological theme of the essay (e.g. importance) at <u>A-level standard</u> .

The ways in which water and the regulation of water content are important to organisms.

In order to fully address the question and reach the highest mark bands students must also include at least five topics in their answer, to demonstrate a synoptic approach to the essay.

Specification reference	Topic area
3.1.1	Monomers and polymers – carbohydrates – lipids – proteins
3.1.7	Water
3.2.3	Transport across membranes – osmosis – water potentials

3.3.2	Gas exchange – plants
3.3.2	Gas exchange – fish
3.3.2	Gas exchange – insects
3.3.4.1	Mass transport in animals - blood – circulation
3.3.4.1	Mass transport in animals – tissue fluid and formation
3.3.4.2	Mass transport in plants – transpiration stream
3.3.4.2	Mass transport in plants – translocation
3.5.1	Photosynthesis
3.5.4	Nutrient cycles – leaching and eutrophication
3.6.1	Growth responses in plants
3.6.4	Homeostasis
3.6.4.3	Control of blood and water potential

In order to fully address the question and reach the highest mark bands students must also include at least four topics in their answer, to demonstrate a synoptic approach to the essay.

Students may be able to show the relevance of other topics from the specification.

Note, other topics from beyond the specification can be used, providing they relate to the title and contain factually correct material of at least an A-level standard. Credit should not be given for topics beyond the specification which are below A-level standard.

[25]

Q8.

- | | | |
|-----|--|---|
| (a) | 1. Dissolve in alcohol, then add water;
2. White emulsion shows presence of lipid. | 2 |
| (b) | Glycerol. | 1 |
| (c) | Ester. | 1 |
| (d) | Y (no mark)
Contains double bond between (adjacent) carbon atoms in hydrocarbon chain. | 1 |
| (e) | 1. Divide mass of each lipid by total mass of all lipids (in that type of cell);
2. Multiply answer by 100. | 2 |
| (f) | Red blood cells free in blood / not supported by other cells so cholesterol helps to maintain shape; | |

Allow converse for cell from ileum – cell supported by others in endothelium so cholesterol has less effect on maintaining shape.

1

- (g) 1. Cell unable to change shape;
2. (Because) cell has a cell wall;
3. (Wall is) rigid / made of peptidoglycan / murein.

2 max

[10]

Q9.

- (a) 1. Starch formed from α -glucose but cellulose formed from β -glucose;
2. Position of hydrogen and hydroxyl groups on carbon atom 1 inverted.

2

- (b) 1. Insoluble;
2. Don't affect water potential;

OR

3. Helical;
Accept form spirals
4. Compact;

OR

5. Large molecule;
6. Cannot leave cell.

2

- (c) 1. Long and straight chains;
2. Become linked together by many hydrogen bonds to form fibrils;
3. Provide strength (to cell wall).

3

[7]

Q10.

- (a) 1. Helicase;
2. Breaks hydrogen bonds;
3. Only one DNA strand acts as template;
4. RNA nucleotides attracted to exposed bases;
5. (Attraction) according to base pairing rule;
6. RNA polymerase joins (RNA) nucleotides together;
7. Pre-mRNA spliced to remove introns.

6 max

- (b) 1. Polymer of amino acids;
2. Joined by peptide bonds;
3. Formed by condensation;
4. Primary structure is order of amino acids;
5. Secondary structure is folding of polypeptide chain due to hydrogen bonding;

Accept alpha helix / pleated sheet

6. Tertiary structure is 3-D folding due to hydrogen bonding and ionic / disulfide bonds;

7. Quaternary structure is two or more polypeptide chains.

5 max

- (c) 1. Hydrolysis of peptide bonds;
2. Endopeptidases break polypeptides into smaller peptide chains;
3. Exopeptidases remove terminal amino acids;
4. Dipeptidases hydrolyse / break down dipeptides into amino acids.

4

[15]

Q11.

- (a) 1. Maltose;
2. Salivary amylase breaks down starch.

2

(b) Maltase.

1

(c) (Mimics / reproduces) effect of stomach.

1

- (d) 1. Add boiled saliva;
2. Everything same as experiment but salivary amylase denatured.

2

- (e) 1. Some starch already digested when chewing / in mouth;
2. Faster digestion of chewed starch;
3. Same amount of digestion without chewing at end.

Accept use of values from graph

3

[9]

Q12.

- (a) 1. **A:** phospholipid (layer);
1. Reject hydrophobic / hydrophilic phospholipid
2. **B:** pore / channel / pump / carrier / transmembrane / intrinsic / transport protein;
2. Ignore unqualified reference to protein

2

(b) (i) Condensation (reaction);

1

- (ii) Organelle named; Function in protein production / secretion;
Function must be for organelle named
Incorrect organelle = 0

eg

1. Golgi (apparatus);
1. Accept smooth endoplasmic reticulum
2. Package / process proteins;

OR

3. Rough endoplasmic reticulum / ribosomes;
3. Accept alternative correct functions of rough endoplasmic reticulum. ER / RER is insufficient
3. Accept folding polypeptide / protein
4. Make polypeptide / protein / forming peptide bonds;

OR

5. Mitochondria;
6. Release of energy / make ATP;
6. Reject produce / make energy
6. Accept produce energy in the form of ATP

OR

7. Vesicles;
8. Secretion / transport of protein;

2

[5]

Q13.

- (a) (i) Glucose and fructose;
Ignore reference to alpha and beta
Either way around

1

- (ii) Glucose and galactose;
Ignore reference to alpha and beta
Either way around

1

- (b) 1. (Amylase) pancreas, produces maltose;
Place and product = 1 mark
(mark horizontally)
2. (Maltase) in / on epithelium (of small intestine), produces glucose;
Ignore references to salivary glands or saliva
Accept wall / lining of small intestine
Ignore reference to cells alone
Ignore reference to ribosomes / rER

2

[4]

Q14.

(a)

Statement	Starch	Cellulose	Glycogen
-----------	--------	-----------	----------

Found in plant cells	✓	✓	
Contains glycosidic bonds	✓	✓	✓
Contains β -glucose		✓	

One mark for each correct row

3

(b) Hydrolysis;

Accept: if phonetically correct

Do not accept: 'hydration'

1

(c) 1. Coiled / helical / spiral;

Feature = one mark

Explanation = one mark

Note: these are independent marking points

These must be related for both marks but can be in reverse order

2. (So) compact / tightly packed / can fit (lots) into a small space;

3. Insoluble;

4. (So) no osmotic effect / does not leave cell / does not affect water potential;

Accept: prevents osmosis

5. Large molecule / long chain;

6. (So) does not leave cell / contains large number of glucose units;

4. and 6. Accept: can't cross membranes

7. Branched chains;

8. (So) easy to remove glucose;

2 max

(d) Two marks for correct answer of 479 - 521;

Accept: measured and actual lengths in different but correct units for 1 mark

One mark for incorrect answers in which candidate clearly divides measured length by actual length;

The actual range is 23 - 25mm, If they just divide this by 48 they gain 1 mark

Just writing the formula is insufficient, numbers must be used

2

[8]

Q15.

- (a) (i) β / Beta glucose;
Accept b / B
Reject any reference to alpha / α 1
- (ii) Glycosidic;
Reject references to α (1-4) glycosidic bond, but allow beta 1-4, or unspecified reference to 1-4 (1,4) 1
- (iii) OH / hydroxyl / HO;
Reject hydroxide
Reject OH / HO molecule
Ignore alcohol 1

(b) (i)

Starch	Cellulose
1. (1,4 and) 1,6 bonds / contains 1,6 bonds / branching	1. 1,4 bonds / no 1,6 bonds / unbranched / straight;
2. All glucoses / monomers same way up	2. Alternate glucoses / monomers upside down;
3. Helix / coiled / compact	3. Straight;
4. Alpha glucose	4. Beta glucose;
5. No (micro / macro) fibrils / fibres	5. Micro / macro fibrils / fibres;

1 mark per pair of contrasts, both starch and cellulose required

*Accept other comparable differences eg hydrogen bonds **within** starch but **between** cellulose molecules*

2 max

- (ii) 1. H-bonds / micro / macro fibrils / fibres;
Reject strong hydrogen bonds
2. Strength / rigidity / inelasticity;
'Strong hydrogen bonds' = 0 but 'Strong hydrogen bonds give strength (to the molecule)' = 1 2

[7]

Q16.

- (a) (i) Repeating units / nucleotides / monomer / molecules;

Allow more than one, but reject two

1

- (ii) 1. C = hydrogen bonds;
2. D = deoxyribose;
Ignore sugar
3. E = phosphate;
Ignore phosphorus, Ignore molecule

3

(iii)

Name of base	Percentage
Thymine	34
Cytosine / Guanine	16
Adenine	34
Cytosine / Guanine	16

Spelling must be correct to gain MP1

First mark = names correct

Second mark = % correct, with adenine as 34%

2

- (b) (i) 153;

1

- (ii) Some regions of the gene are non-coding / introns / start / stop code / triplet / there are two DNA strands;

Allow addition mutation

Ignore unqualified reference to mutation

Accept reference to introns and exons if given together

Ignore 'junk' DNA / multiple repeats

1

[8]

Q17.

- (a) Amino acid / amino acids ;

If anything else is given as well do not award mark.

1

- (b) (i) 1. Affects one monomer / amino acid;
i.e. What is affected
2. Not found in all active sites;
i.e. Where it is found.
2. Must relate to active site. Enzyme is insufficient.

2

- (ii) 1. **X**;

2. Enzyme in both pathways;
2. Award independently
- 2
- (c) 1. Occupies / blocks / binds to active site;
i.e. What it does in terms of the active site.
2. Substrate will not fit / does not bind / no longer complementary to / enzyme-substrate complex not formed;
1. Ignore references to change in shape and shape of aspirin molecule.
Ignore reference to competitive inhibitor *i.e.* Consequence required

2

[7]

Q18.

- (a) (i) Hydrolysis;
Accept phonetic spelling.
Ignore reaction.
- 1
- (ii) (Alpha) glucose;
Accept α glucose.
Reject β glucose / beta glucose
- 1
- (b) (i) Add Benedict's (reagent) and heat / warm;
Red / orange / yellow / green (colour);
Reject Add HCl
Accept brown, reject other colours
- 2
- (ii) 2 products / 2 sugars produced;
*Look for idea of **two***
Accept named monosaccharides produced.
"More" insufficient for mark
Neutral if incorrect products named
Neutral "lactose is a polysaccharide"
Neutral "lactose is not a reducing sugar"
Neutral: Reference to surface area.
- 1
- (c) 1. Galactose is a similar shape / structure to lactose / both complementary;
Q Reject: Same shape / structure
2. (Inhibitor / Galactose) fits into / enters / binds with active site (of enzyme);
Accept blocks active site
3. Prevents / less substrate fitting into / binding with (active site) / fewer or no E-S complexes;

- Look for principles:*
1. *Shape*
 2. *Binding to active site*
 3. *Consequence*

2 max

[7]

Q19.

- (a) 1. Hydrolysis breaks proteins / hydrolyses proteins / produces amino acids (from proteins);
2. Protein synthesis involves condensation;
- 2
- (b) Amino acids (from calliphorin) can be joined in different sequences / rearranged;
- 1
- (c) 1. Fall, rise and fall;
2. Rise after 40 and fall after 80;
Ignore concentration values.
- 2
- (d) (i) Fall / increase then fall;
- Lysosomes associated with tissue breakdown;
- 2
- (ii) 1. Tissues / cells are being broken down;
2. RNA is digested / hydrolysed / broken down;
3. By enzymes from lysosomes;
4. New proteins not made / no new RNA made;
- 2 max
- (e) 1. (RNA) associated with making protein;
2. New / adult tissues are forming;
- 2
- (f) 1. In the first 6 days no / little oxygen supplied / with breakdown of tracheae, no / little oxygen supplied;
2. (Without tracheae) respire anaerobically;
3. Anaerobic respiration involves reactions catalysed by enzyme **B** / conversion of pyruvate to lactate / involves lactate production;
4. Enzyme **A** / Krebs cycle is part of aerobic respiration;
Or, with emphasis on aerobic respiration:
1. *Tracheae supply oxygen / after 6 days oxygen supplied;*
 2. *(With tracheae) tissues can respire aerobically.*
- 4

Q20.

- (a) Double bond(s);

(Bonds) between carbon;

*C=C bond(s) = 2 marks**'No' C=C bond(s) disqualifies 1 mark only**Accept: does not contain maximum number of H for 1 mark**Neutral: contains C=O bonds*

2

- (b) Graph shows negative correlation / description given;

Correlation does not mean causation / prevention / shows lower risk not prevention;

May be due to another factor / example given;

*Neutral: refs. to methodology e.g. sample size / line of best fit**Q: Do not allow 'casual' relationship*

3

- (c) (i) Glycosidic;

*Accept: if phonetically correct**Reject: ester bond*

1

- (ii) Contains glycerol /
- three
- fatty acids / forms
- three
- ester bonds;

*Neutral: contains less fatty acids**Answers must refer to a triglyceride**Ignore refs. to incorrect bond names**Neutral: olestra has eight fatty acids / R groups**Reject: contains three glycerols*

1

- (iii) 9;

1

[8]**Q21.**

- (a) Helical / spiral / coiled;
-
- Compact / description e.g. 'tightly packed';

*Feature = one mark**Explanation = one mark*

Insoluble;

Prevents osmosis / uptake of water / does not affect water potential / (starch) does not leave cell;

These must be related for both marks but can be in reverse order.

Large molecule / long chain;
Does not leave cell;

*Allow idea of compact / helical / spiral / coiled due to bonding
for two marks.*

2 max

(b) (i) β / beta Glucose;

Q Reject alpha glucose

1

(ii) Glycosidic;

1

(c) Long / straight / unbranched chains (of glucose joined by) hydrogen bonds;

Q Ignore reference to alpha glucose

Form (micro)fibrils / (macro)fibrils;

Provide rigidity / strength / support;

*Allow suitable descriptions for last point e.g. 'prevents
bursting';*

3

[7]

Q22.

(a) (i) (Lactose +) Water; \rightarrow (Glucose +) Galactose;

Accept: H₂O for water

2

(ii) Hydrolysis;

Accept: if phonetically correct

1

(b) (i) (Add Biuret reagent to both solutions) – no mark;

Neutral: positive / negative result

Lactase / enzyme will give purple / lilac / mauve;

Neutral: incorrect reference to the method

OR

Lactose / reducing sugar will not give purple / lilac / mauve / will remain
blue;

1

(ii) Lactase / enzyme is a protein;

Accept: lactase / enzyme contains peptide bonds

1

[5]

Q23.

(a) (i) Glucose;

Fructose;

Any order.

2

- (ii) Lactose has a different shape / structure;

Does not fit / bind to active site of enzyme / sucrase;

Only allow a second mark if reference is made to the active site.

Max 1 mark if active site is described as being on the substrate.

OR

Active site of enzyme / sucrase has a specific shape / structure; Does not fit / bind to lactose;

Do not accept same shape.

2

- (b) (i) Rose and fell;

Peak at 45 (minutes) / concentration of 6.6 (mmol dm⁻³);

2

- (ii) Glucose (produced by digestion) is absorbed / enters blood;

Decrease as used up / stored;

2

[8]

Q24.

21 – 25	Extended abstract Generalised beyond specific context	Response shows holistic approach to the question with a fully integrated answer which makes clear links between several different topics and the theme of the question. Biology is detailed and comprehensive A-level content, uses appropriate terminology, and is very well written and always clearly explained. No significant errors or irrelevant material. For top marks in the band, the answer shows evidence of reading beyond specification requirements.
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		answer.
11 – 15	Multistructural Several aspects covered but they are unrelated	Response mostly deals with suitable topics but they are not interrelated and links are not made to the theme of the question. Biology is usually correct A-level content, though it lacks detail. It is usually clearly explained and generally uses appropriate terminology. Some significant errors and, or, more than one irrelevant topic.
6 – 10	Unistructural Only one or few aspects covered	Response predominantly deals with only one or two topics that relate to the question. Biology presented shows some superficial A-level content that may be poorly explained, lacking in detail, or show limited use of appropriate terminology. May contain a number of significant errors and, or, irrelevant topics.
1 – 5	Unfocused	Response only indirectly addresses the theme of the question and merely presents a series of biological facts which are usually descriptive in nature or poorly explained and at times may be factually incorrect. Content and terminology is generally below A-level. May contain a large number of errors and, or, irrelevant topics.
0		Nothing of relevance or no response.

Commentary on terms and statements in the levels mark scheme

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Levels mark scheme word/statement	Definition
Holistic	Synoptic, drawing from different topics (usually sections of the specification)
A fully integrated answer which makes clear links between several different topics and the theme of the question	All topics relate to the title and theme of the essay; for example, explaining the biological importance of a process. When considering, for example, the importance of a process, the explanation must be at A-level standard. 'Several' here is defined as at least four

	topic areas from the specification covered. This means some sentences, not just a word or two. It does not mean using many examples from one topic area.
Biology is detailed and comprehensive A-level content, uses appropriate terminology, and is very well written and always clearly explained.	Detailed and comprehensive A-level content is the specification content. Terminology is that used in the specification. Well written and clearly explained refers mainly to biological content and use of terminology. Prose, handwriting and spelling are secondary considerations. Phonetic spelling is accepted, unless examiners are instructed not to do so for particular words; for example, glucagon, glucose and glycogen.
No significant errors or irrelevant material.	A significant error is one which significantly detracts from the biological accuracy or correctness of a described example. This will usually involve more than one word. Irrelevant material is several lines (or more) that clearly fails to address the title, or the theme of the title.
For top marks in the band, the answer shows evidence of reading beyond specification requirements.	An example that is relevant to the title and is not required in the specification content. The example must be used at A-level standard.
Response mostly deals with suitable topics but they are not interrelated and links are not made to the theme of the question.	Not addressing the biological theme of the essay (e.g. importance) at <u>A-level standard</u> .

Please note that to obtain full credit, students must use information to show **the importance of how the structures of different polymers are related to their functions**.

Topics

3.1.1	Monomers and polymers
3.1.2	Carbohydrates
3.1.4	Proteins
3.1.5	Nucleic acids

3.2.3	transport across membranes
3.2.4	Cell recognition and the immune system
3.3.3	Digestion and absorption
3.4.1	DNA, genes and chromosomes

In order to fully address the question and reach the highest mark bands students must also include at least four topics in their answer, to demonstrate a synoptic approach to the essay.

Students may be able to show the relevance of other topics from the specification.

Note, other topics from beyond the specification can be used, providing they relate to the title and contain factually correct material of at least an A-level standard. Credit should not be given for topics beyond the specification which are below A-level standard.

[25]

Q25.

- (a) (i) both are polymers / polysaccharides / built up from many sugar units / both contain glycosidic bonds / contain (C)arbon, (H)ydrogen and (O)xygen; 1
- (ii) hemicellulose shorter / smaller than cellulose / fewer carbons; hemicellulose from pentose / five-carbon sugars and cellulose from hexose / glucose / six-carbon sugars;
 (only credit answers which compare like with like.) 2
- (b) protein / nucleic acid / enzyme / RNA / DNA / starch / amylose / amylopectin polypeptide; 1
- (c) (i) to make sure that all the water has been lost; 1
- (ii) only water given off below 90 °C; (above 90°C) other substances straw burnt / oxidised / broken down; and lost as gas / produce loss in mass; 2
- (d) enzymes are specific; shape of lignin molecules will not fit active site (of enzyme);
 OR
 shape of active site (of enzyme); will not fit molecule; 2 max
- (e) 1. made from β -glucose;
 2. joined by condensation / removing molecule of water / glycosidic bond;
 3. 1 : 4 link specified or described;
 4. "flipping over" of alternate molecules;
 5. hydrogen bonds linking chains / long straight chains;
 6. cellulose makes cell walls strong / cellulose fibres are strong;
 7. can resist turgor pressure / osmotic pressure / pulling forces;
 8. bond difficult to break;

9. resists digestion / action of microorganisms / enzymes;
(allow maximum of 4 marks for structural features)

6 max

[15]

Q26.

- (a) (i) (Molecule) made up of many identical / similar molecules / monomers / subunits;
Not necessary to refer to similarity with monomers. 1
- (ii) Cellulose / glycogen / nucleic acid / DNA / RNA; 1
- (b) (i) To keep pH constant;
A change in pH will slow the rate of the reaction / denature the amylase / optimum for reaction; 2
- (ii) Purple / lilac / mauve / violet;
Do not allow blue or pink. 1
- (iii) Protein present / the enzyme / amylase is a protein;
Not used up in the reaction / still present at the end of the reaction; 2

[7]

Q27.

- (a) (i) condensation; 1
- (b) (i) **D**; 1
- (ii) **C**; 1
- (iii) **A**; 1
- (c) absence of a double bond;
in the (hydrocarbon) chain;
unable to accept more hydrogen / saturated with hydrogen; 2 max

[6]