Q1.

Starch contains two different molecules, amylose and amylopectin. The percentage of each molecule found in starch varies depending on its source.

The effect of amylose content on the hydrolysis of starch from different sources by enzymes was investigated.

Source of starch	Amylose content (%)	Percentage of starch hydrolysed after 4 hours (%)
Cassava	20.0	51.9
Peruvian carrot	18.7	54.2
Potato	28.9	39.6
Yellow maize	35.8	37.5

(i) Calculate the ratio of amylose to amylopectin in cassava. Give your answer in simplest form.

(1)

Answer .....

(ii) Explain the relationship between the composition of the starch and the rate of hydrolysis by enzymes.

(4)

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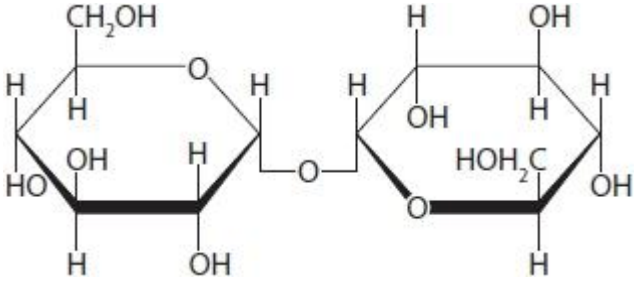
(Total for question = 5 marks)

Q2.

Maltose and trehalose are disaccharides. Trehalose is formed from two molecules of α-glucose.
The diagram shows a molecule of trehalose.



(i) Describe the reaction that joins two α-glucose molecules to form a disaccharide.

(2)

(ii) Compare and contrast the structures of trehalose and maltose.

(2)

(Total for question = 4 marks)

Q3.

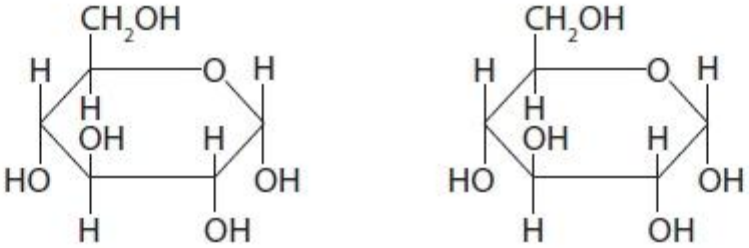
There are a number of reactions that regularly occur in cells.

Condensation reactions can be used to join a number of molecules together.

(i) The diagram shows two substrate molecules.

Draw the products when a condensation reaction occurs between the two substrate molecules.

(2)



(ii) Name the larger product formed in this reaction.

(1)

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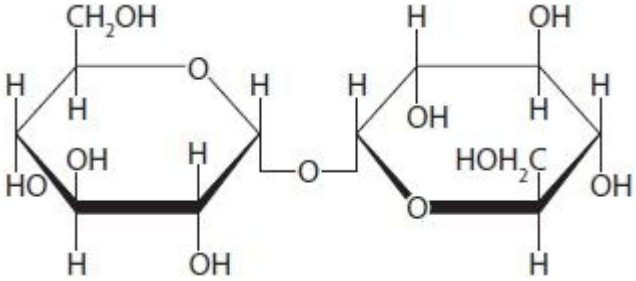
Q4.

Maltose and trehalose are disaccharides. Trehalose is formed from two molecules of α-glucose.

The diagram shows a molecule of trehalose.



Some flying insects store trehalose and glycogen in their wing muscles.

(i) Trehalose is broken down to glucose by the enzyme trehalase.

Which of the following describes how glucose is produced from trehalose?

(1)

- ☒ **A** anabolism
- ☒ **B** catalysis
- ☒ **C** glycolysis
- ☒ **D** hydrolysis

(ii) Insect flight uses a lot of energy. Explain the advantage of insects storing both trehalose and glycogen.

(4)

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(Total for question = 5 marks)

Q5.

Glucagon is a hormone that is usually released when the level of blood glucose falls too low.
Glucagon stimulates the liver to break down glycogen into glucose.

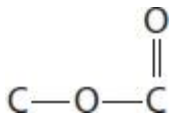
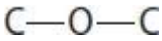
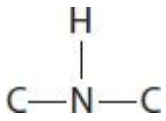
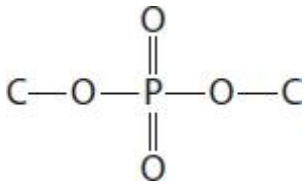
(i) Which of the following processes breaks down glycogen into glucose?

(1)

- ☒ **A** condensation
- ☒ **B** hydrolysis
- ☒ **C** methylation
- ☒ **D** phosphorylation

(ii) Which arrangement shows the structure of the bond that is broken in this process?

(1)

- ☒ **A** 
- ☒ **B** 
- ☒ **C** 
- ☒ **D** 

Q6.

Endurance athletes, such as marathon runners, often 'carb load' before an event.
This involves eating food containing large quantities of starch.

Describe the structure of starch.

(4)

Q7.

Blood plasma contains glucose dissolved in water. Glucose is a polar molecule that is taken up by muscle cells and used in the synthesis of glycogen.

Glucose is used in the synthesis of glycogen in muscle cells.

(i) Describe the formation of glycogen from glucose.

(2)

(ii) Describe how the structure of glycogen is related to its function as a storage molecule.

(2)

(Total for question = 4 marks)

Q8.

Lipases are enzymes that are involved in the breakdown of lipids, such as triglycerides.

(i) Name the bond broken by lipases.

(1)

_____

(ii) Name **two** products formed from the breakdown of triglycerides by lipases.

(2)

1 _____

2_____

(iii) Suggest what effect the breakdown of triglycerides could have on the pH of a reaction mixture.

(1)

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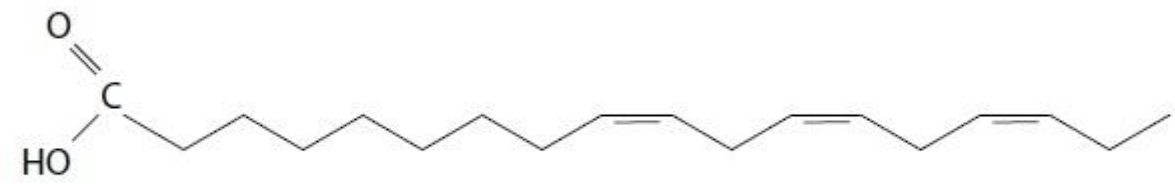
(Total for question = 4 marks)

Q9.

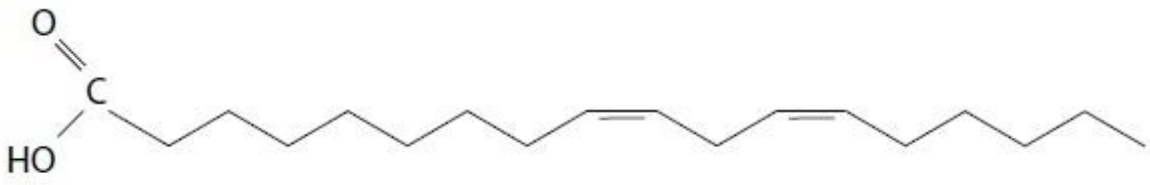
Some fatty acids are classed as essential fatty acids. These fatty acids need to be included in our diet, because the human metabolism cannot synthesise them. Omega 3 and omega 6 are two examples of essential fatty acids.

(a) The diagrams below represent the structures of the fatty acids omega 3 and omega 6.

Omega 3



Omega 6



(i) Using the diagram of omega 3 above, describe its structure.

(2)

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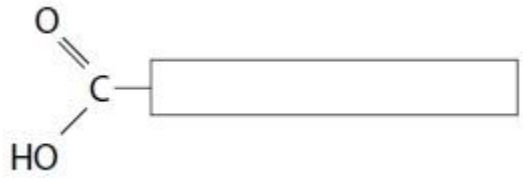
(ii) Give **one** difference between the structure of omega 3 and the structure of omega 6.

(1)

_____

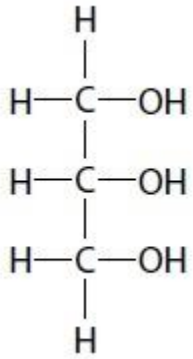
_____

(iii) The diagram below shows a more simplified structure of omega 3.



A glycerol molecule is drawn below. Use these diagrams to show how **one** omega 3 molecule bonds to the glycerol molecule, by means of a condensation reaction, during the synthesis of a triglyceride.

(3)



(Total for question = 6 marks)

Q10.

Triglycerides, amylose and glycogen are used to store energy in many living organisms.

Use a labelled diagram to show how a triglyceride is formed.

(3)

(Total for question = 3 marks)

Mark Scheme

Q1.

Question Number	Answer	Additional Guidance	Mark
(i)	• correct answer (1)	Example of calculation 100 – 20 = 80 20 : 80 = 1 : 4 **1 : 4** Do not allow any reference to percentages	(1)

Question Number	Answer	Additional Guidance	Mark
(ii)	An explanation that makes reference to four of the following: • as amylose content increases the percentage of starch hydrolysed decreases (1) • the less amylose present the greater the proportion of amylopectin (1) • amylose is unbranched / amylopectin is branched (1) • amylopectin contains (1,4 and) 1,6-glycosidic bonds (1) • { branches / a greater number of terminal ends } increases the rate of hydrolysis (1)	Allow converse Allow converse	(4)

Q2.

Question number	Answer	Additional guidance	Mark
(i)	A description that makes reference to the following: • condensation (1) • involving OH groups (on both molecules) / water is formed (1)		(2)

Question number	Answer	Additional guidance	Mark
(ii)	An answer that makes reference to the following: • both are formed from two molecules of (α)glucose / both contain a glycosidic bond (1) • maltose has (α-)1,4 linkage and trehalose has (α-)1,1 linkage / in trehalose one of the glucose monomers is inverted (1)	ALLOW both are disaccharides of glucose DO NOT ALLOW β - glucose	(2)

Q3.

Question Number	Acceptable Answer	Additional Guidance	Mark
(i)	An answer that makes reference to the following: • water (1) • glycosidic bond drawn correctly (1)		**(2)**

Question Number	Acceptable Answer	Additional Guidance	Mark
(ii)	maltose		**(1)**

Q4.

Question number	Answer	Mark
(i)	**The only correct answer is D – hydrolysis** ***A*** *is not correct because anabolism is associated with forming more complex molecules* ***B*** *is not correct because catalysis is a general term for enzyme controlled reactions* ***C*** *is not correct because glycolysis is a sequence of reactions in respiration*	(1)

Question number	Answer	Additional guidance	Mark
(ii)	An explanation that makes reference to the following: • glucose used in respiration to provide { energy / ATP } (1) • glycogen is a polymer of glucose (1) • glycogen has lots of { branches / terminal ends } so it can release glucose rapidly (1) • breakdown of trehalose { makes two molecules of glucose available / provides a more immediate source of glucose } (1)	ALLOW glycogen contains lots of glucose ALLOW quickly hydrolysed	(4)

Q5.

Question Number	Answer	Additional Guidance	Mark
(i)	B (hydrolysis)		**(1)**

Question Number	Answer	Additional Guidance	Mark
(ii)	B (C - O - C)		**(1)**

Q6.

Question Number	Acceptable Answer	Additional Guidance	Mark
	A description that makes reference to the following: • starch is a polysaccharide made from alpha glucose units (1) • units in the chains are joined by 1,4 glycosidic links (1) • starch contains { unbranched chains / amylose } and { branched chains / amylopectin } (1) • branches are joined to chains by 1,6 glycosidic links (1)	Glucose alone is insufficient	**(4)**

Q7.

Question Number	Answer	Additional Guidance	Mark
(i)	A description which includes reference to the following: • joining together in condensation reactions (1) • forming {1,4 and 1,6} glycosidic bonds (1)		**(2)**

Question Number	Answer	Additional Guidance	Mark
(ii)	A description which includes reference to the following: • branched molecule for more rapid hydrolysis (1) • compact so more can be stored (1)	ALLOW broken down ALLOW 'doesn't take up much space'	**(2)**

Q8.

Question Number	Answer	Mark
(b)(i)	ester ;	**(1)**

Question Number	Answer	Mark
(b)(ii)	Any **two** from: 1. fatty acid (s) / carboxylic acid(s) 2. glycerol / propan1,2,3 triol 3. monoglyceride 4. diglyceride ;;	**(2)**

Question Number	Answer	Mark
(b)(iii)	(pH) would {fall / drop / get lower / decrease / eq} ;	**(1)**

Q9.

Question Number	Answer	Mark
(a)(i)	1. reference to {COOH/ carboxylic/ acid} grouping (at one end) ; 2. (long hydro)carbon chain / eq ; 3. 18 carbons / 17 carbons in hydrocarbon chain / eq ; 4. Correct reference to (poly) unsaturated ; 5. 3 carbon-carbon double bonds / 4 double bonds ; 6. kinked structure / eq ;	max (2)

Question Number	Answer	Mark
(a)(ii)	Any one from 1. omega 3 has {3 carbon-carbon double bonds / 4 double bonds} , omega 6 has {2 / 3 } / eq ; 2. omega 3 has less hydrogens / eq ; 3. omega 3 is {kinkier / shorter} / eq ; 4. omega 3 less saturated / eq ;	max (1)

Question Number	Answer	Mark
(a)(iii)	1. indication that fatty acid forms a bond with the OH group of the glycerol molecule ; 2. indication that water is formed ; 3. ester bond correctly drawn ;	(3)

Q10.

Question Number	Answer	Additional Guidance	Mark
	1. glycerol plus three fatty acids as reactants ; 2. ester bond labelled ; 3. water shown ;	**2 ACCEPT** an ester bond drawn out correctly even if not labelled	(3)