Enzymes (CC4): Eduqas A Level Biology Exam Questions by Topic

20 questions · 44 marks · about 53 minutes. Answer in the spaces, then check the mark schemes at the end.

Question 1 · A level Component 3 · June 2022 · Q3(c)(ii) · 2 marks

The scientists then poured water into the column which contained immobilised endopeptidase and exopeptidase and collected the resulting liquid at the end of the column.

(ii) Describe how they could test the resulting liquid to show that no enzyme had left the column. Explain why this test is used. [2]

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Question 2 · A level Component 2 · June 2023 · Q1(a)(i) · 1 mark

1. (a) Restriction endonucleases are found in bacterial cells. They are used by these cells to cut the DNA of viruses that infect the bacteria. These viruses are called bacteriophages.

(i) State the name given to enzymes which work inside cells. [1]

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Question 3 · A level Component 3 · June 2024 · Q5(a)(i) · 2 marks

5. The kidneys play an important role in homeostasis through osmoregulation and the excretion of urine.

The volume of urine produced can be affected by both the glomerular filtration rate and the reabsorption of filtrate.

(a) To control the glomerular filtration rate, a protein is released by the body which causes vasoconstriction of the afferent arterioles. This protein functions as both an enzyme and a hormone.

(i) Describe what is meant by the term enzyme and explain why the tertiary structure of the enzyme is important to the function of the enzyme. [2]

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The formation of glycoproteins on red blood cell membranes is carried out by enzymes.

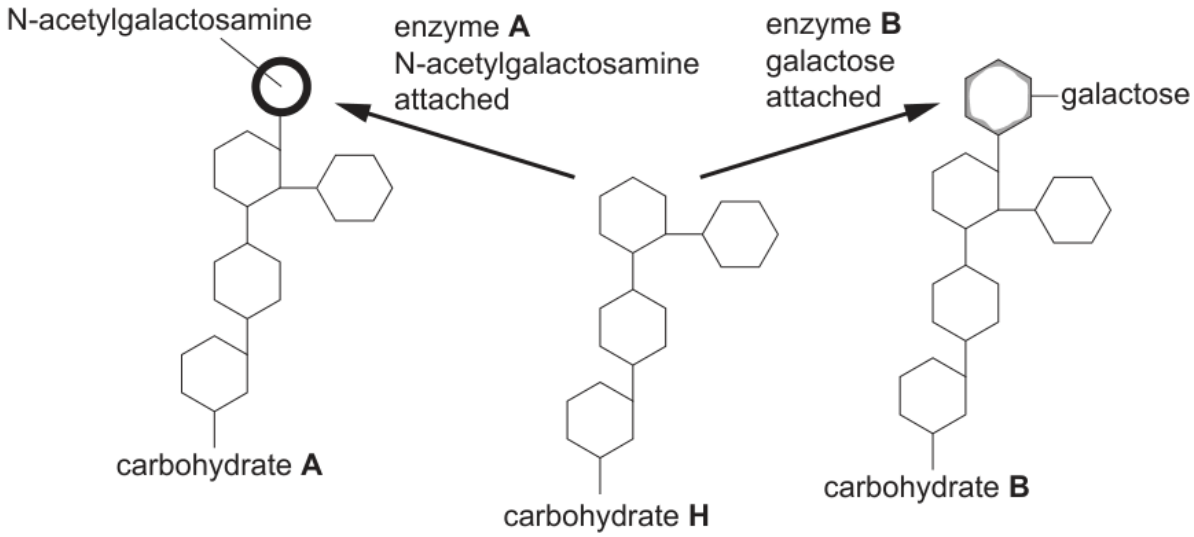
The ABO blood group system depends on the type of glycoproteins present on red blood cells. There are different forms of carbohydrate chain that can be found as part of the glycoprotein. The basic structure of this carbohydrate is called **H**.

N-acetylgalactosamine can be attached to carbohydrate **H** by enzyme **A** to make carbohydrate **A**.

Galactose can be attached to carbohydrate **H** by enzyme **B** to make carbohydrate **B**.

This is summarised in **Image 5.1**.

Image 5.1

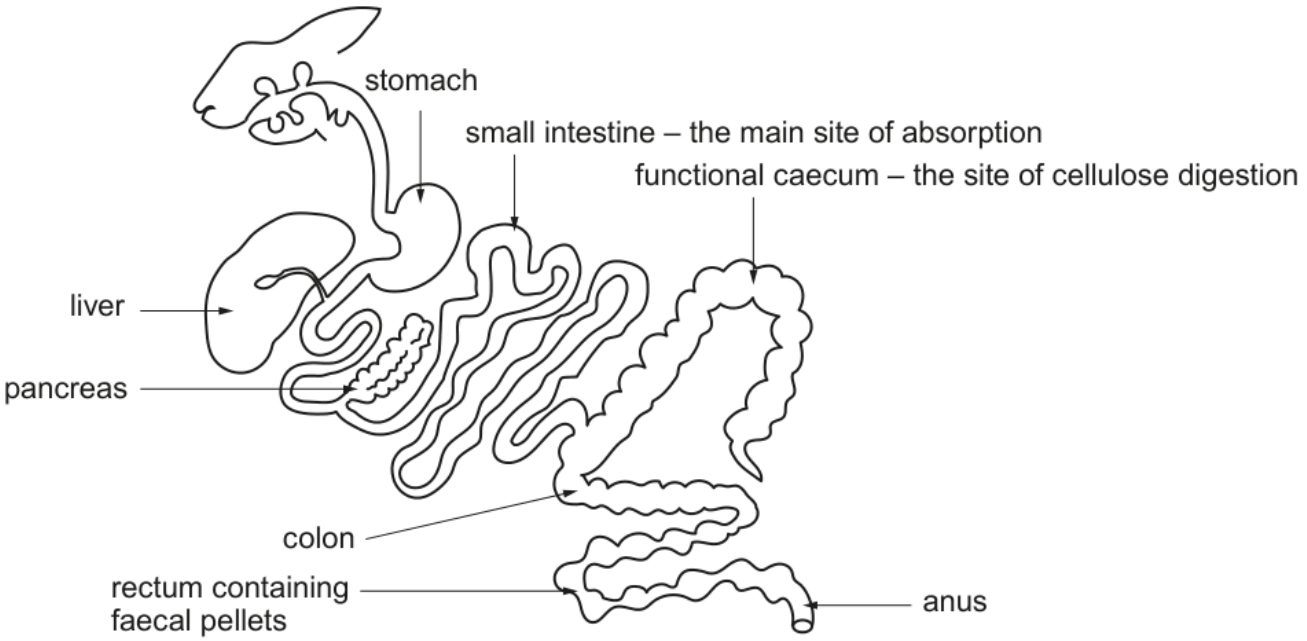


(ii) Use **Image 5.1** to suggest why different enzymes are needed to attach N-acetylgalactosamine and galactose to carbohydrate **H**. [2]

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Question 5 · AS Component 2 · June 2016 · Q6(a)(i) · 3 marks

6. The diagram below shows the digestive system of a rabbit, which is adapted to its high cellulose diet, as a non-ruminant herbivore.



(a) Rabbit cells can produce α amylase to digest starch, but cannot produce an enzyme to digest cellulose.

(i) With reference to the structure of starch and cellulose molecules, explain why α amylase is unable to digest cellulose even though starch and cellulose are both polymers of glucose. [3]

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Question 6 · AS Component 1 · June 2023 · Q1(b)(iii) · 4 marks

(iii) Lysozyme is an enzyme which functions in a way that supports the theory of the induced fit hypothesis. Describe the induced fit hypothesis. [4]

Question 7 · AS Component 1 · June 2023 · Q1(b)(iv) · 2 marks

(iv) Describe how the lock and key hypothesis is different from the induced fit hypothesis. [2]

Question 8 · A level Component 1 · June 2019 · Q2(d) · 3 marks

(d) Describe the effect of heat in the process of pasteurisation on the proteins in the bacteria. [3]

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Question 9 · A level Component 3 · June 2024 · Q2(b) · 1 mark

(b) When vinegar (ethanoic acid) is added to potato chips, enzyme **A** (produced in the mouth) is unable to break down the starch they contain. Suggest the reason for this. [1]

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Question 10 · information from earlier in the question

3. Many plants, especially those which have been selectively bred to produce food for humans are polyploid, with several complete sets of chromosomes. For example, wild strawberries, are 2n = 14 but those grown commercially are octoploid, with eight sets of chromosomes.

Strawberries are often used as a source of DNA for extraction in a school laboratory. The following method was used to extract DNA from a strawberry.

1. Place a strawberry in a sealable plastic bag and crush.
2. Add 10 cm^3 of a mixture containing 1 cm^3 of detergent (pH 9), 0.1 g of salt and 10 cm^3 of water to the bag and mix thoroughly with the crushed strawberry.
3. Place the bag containing the strawberry mixture in a water bath at 60 °C for 15 minutes.
4. Cool the contents by placing the bag in a water bath of iced water.
5. Filter the mixture through a coffee filter paper into a clean beaker. Keep the filtrate.
6. Place 10 cm^3 of the filtrate in a boiling tube and add 2–3 drops of a protease enzyme and mix. Leave for 2 minutes.
7. Carefully pour ice-cold ethanol down the side of the tube to form a layer 1 cm deep on top of the filtrate. Let it stand for 3–4 minutes.
8. DNA precipitates into the ethanol. It should look cloudy. Using a glass rod, gently lift out some of the DNA.

Question 10 · A level Component 2 · Autumn 2020 · Q3(b)(iii) · 2 marks

(iii) A protease is added to digest enzymes present in the cytoplasm of strawberry cells that could digest the DNA. Explain why you could not use **pepsin** as the protease when following this method. [2]

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(e) A student decided to time how long it takes lipases to digest lipids. She used the indicator phenolphthalein. Phenolphthalein is pink at pH10. When the pH drops below 8.3 it becomes colourless.

When the triglycerides in milk are hydrolysed they form glycerol and fatty acids. The fatty acids reduce the pH to below 8.3.

The student carried out the following procedure:

- 0.5 cm^3 of phenolphthalein was added to 5 cm^3 of milk in a test tube. 7 cm^3 of sodium carbonate (pH10) was added.
- 1 cm^3 of 5% lipase was added to a separate test tube.
- Both tubes were placed in a thermostatic water bath set at 30 °C for 5 minutes.
- The contents of the tubes were combined and then put back in the water bath.
- The time taken for the indicator to become colourless was recorded.
- The procedure was repeated a further four times using the same type of milk.

The results are shown in **table 3.4**.

Table 3.4

Repeat	Time taken for indicator to become colourless / s
1	65
2	53
3	72
4	58
5	68

(i) Explain why the solutions were left in the thermostatic water bath for 5 minutes before combining. [1]

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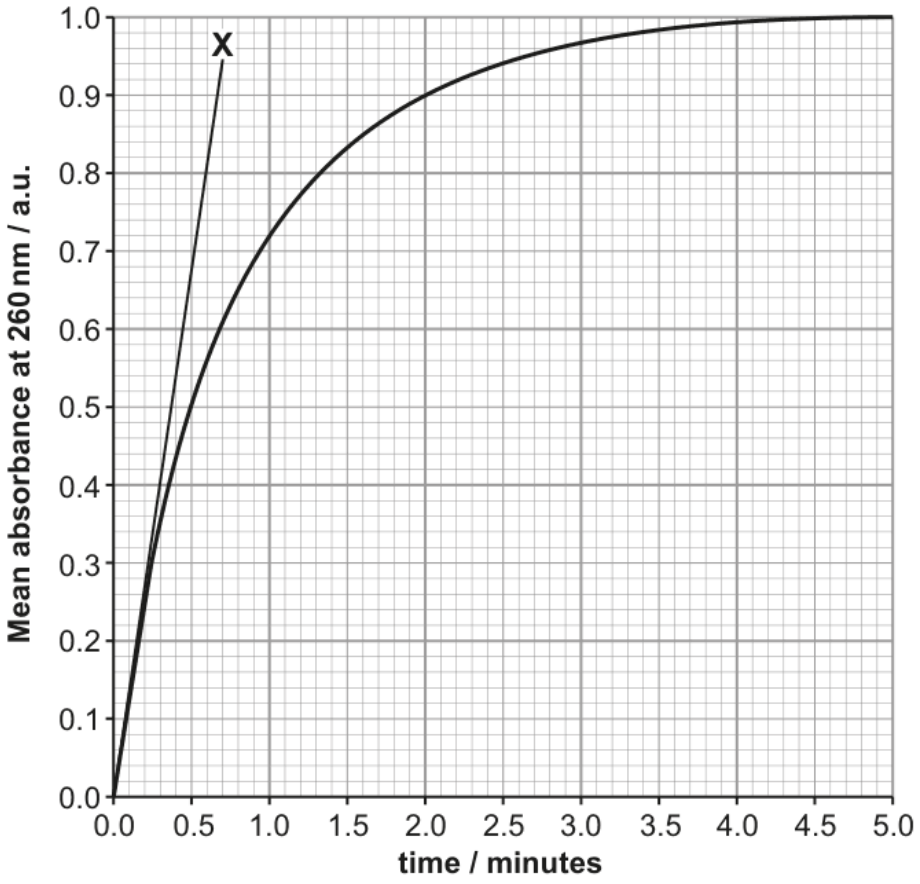
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Question 12 · information from earlier in the question

(b) The rate of digestion of DNA can be determined using a colorimeter. As DNA is digested it absorbs more light at a wavelength of 260 nm.

To determine the rate of reaction of DNase 1, $0.2\,cm^3$ of DNase 1 at $50\,ng\,cm^{-3}$ concentration were mixed with $1.8\,cm^3$ of synthetic single stranded DNA at a concentration of $200\,\mu g\,cm^{-3}$ in a cuvette. The absorbance of light at 260 nm was recorded at intervals for a period of five minutes. The experiment was repeated to give five results. The mean results are plotted on the graph below.



Question 12 · AS Component 1 · June 2017 · Q5(b)(ii) · 2 marks

(ii) Explain the difference between the initial rate and the rate between 0 and 0.5 minutes. [2]

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Question 13 · information from earlier in the question

(c) **Table 3.3** shows the volume of juice recorded using a range of pectinase concentrations.

Table 3.3

Concentration of pectinase / %	Volume of juice / cm^3
0.2	0.5
0.4	1.2
0.6	2.4
0.8	2.5
1.0	2.8
1.2	2.8
1.4	2.8

(i) Plot the data in **Table 3.3** on **Graph 3.4**. [4]

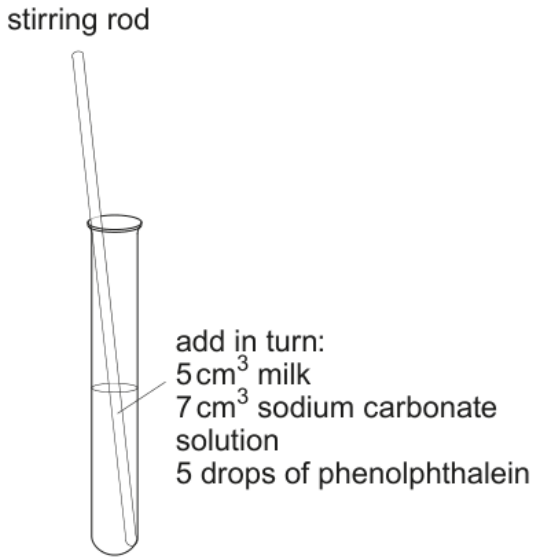
Question 13 · AS Component 1 · June 2024 · Q3(c)(ii) · 4 marks

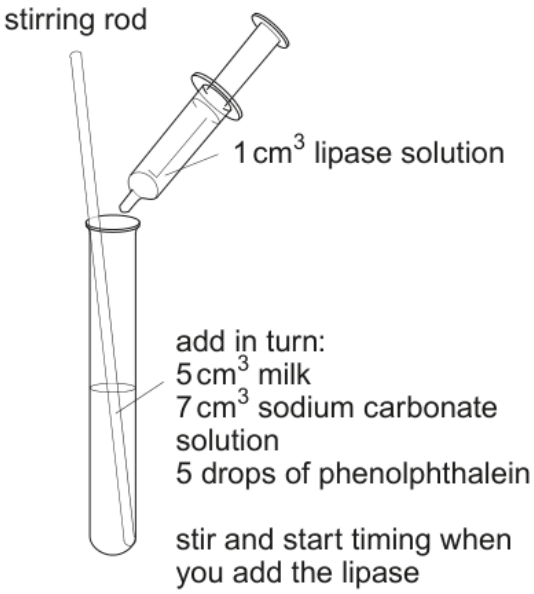
(ii) Use **Graph 3.4** to describe and explain the effect of increasing the concentration of pectinase. [4]

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Question 14 · information from earlier in the question

5. An experiment was set up as shown below with the addition of alkaline sodium carbonate causing the milk to turn pink. Phenolphthalein is a pH indicator which is pink in alkaline conditions and colourless when in acid conditions. The experiment was timed to see how long it took for the indicator to turn from pink to colourless.





Question 14 · AS Component 1 · June 2016 · Q5(b) · 1 mark

(b) Why would this experiment not be suitable for assessing the effect of different pH values on lipase? [1]

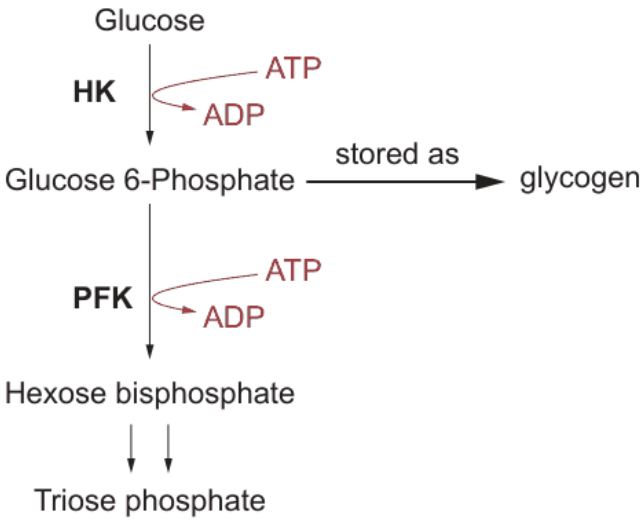
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4. Glycolysis is the initial stage of respiration and involves hydrolysis of glucose and the production of ATP. The diagram below shows part of glycolysis.



Control of glycolysis is largely by end-product inhibition:

- High levels of ATP allosterically inhibit the enzyme PFK in the liver thus lowering its affinity for its substrate.
- PFK is the main regulatory enzyme in glycolysis, but it is not the only one.
- HK, the enzyme catalysing the first step of glycolysis, is inhibited by its product, glucose 6-phosphate.

(a) Explain the term *allosteric inhibition*. [2]

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Question 16 · A level Component 1 · Autumn 2020 · Q3(c) · 2 marks

(c) High levels of ATP within a cell cause the non-competitive inhibition of several enzymes involved in ATP synthesis.

Explain how an ATP molecule could act as a non-competitive inhibitor. [2]

Question 17 · information from earlier in the question

(iii) On contact with the zona pellucida, the acrosome reaction occurs. One of the hydrolytic enzymes released from the acrosome is acrosin. It is stored in the acrosome in a non-hydrolytic form that only becomes active when it is released from the sperm.

Suggest a reason for it being stored in a non-active form. [1]

Question 17 · A level Component 2 · June 2023 · Q4(e)(iii) · 3 marks

(iii) An acrosin inhibitor has been suggested as a form of contraception. Explain how a non-competitive inhibitor could act on acrosin to prevent fertilisation. [3]

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Question 18 · AS Component 1 · June 2016 · Q5(c) · 3 marks

Weight loss in obese patients can be achieved by a reduction in their intake of lipids or by reducing their ability to digest and / or absorb lipids.

One drug used to treat obesity acts as a competitive inhibitor of lipase. It prevents approximately 30% of the lipid being absorbed, thereby reducing energy (calorie) intake. The extra lipid in the large intestine can lead to unpleasant side effects such as diarrhoea and deficiency diseases. Treatment of patients requires them to take vitamin tablets since absorption of fat-soluble vitamins and other fat-soluble nutrients is inhibited by the use of the drug.
After drug treatment was stopped, a significant number of subjects regained up to 35% of the weight they had lost.

(c) Describe and explain the action of this drug on pancreatic lipase. [3]

Question 19 · AS Component 1 · June 2016 · Q3(b) · 2 marks

(b) Modern medicine uses immobilised enzymes, in devices called biosensors, to detect blood glucose levels. This involves the use of glucose oxidase as the enzyme and glucose as the substrate. Give **two** advantages of using immobilised enzymes for blood glucose monitoring. [2]

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Question 20 · A level Component 1 · June 2025 · Q4(d)(i) · 2 marks

(d) The presence and concentration of 'Aphide' can be monitored using a biosensor. This includes immobilised molecules of the enzyme laccase.

(i) State **two** advantages of using **immobilised enzymes** in a biosensor. [2]

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II. .....

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Mark schemes

Question 1 · A level Component 3 · June 2022 · Q3(c)(ii) · 2 marks

(ii)	Add biuret, stays blue (1) Enzyme is a protein (1)	2	2	2	

Question 2 · A level Component 2 · June 2023 · Q1(a)(i) · 1 mark

1	(a)	(i)	Intracellular	1	1

Question 3 · A level Component 3 · June 2024 · Q5(a)(i) · 2 marks

5	(a)	(i)	speeds up (rate of) reactions / biological catalyst / lowers activation energy / catalyses reactions not enough (1)	1		
			active site complementary to (specific) substrate / ref to lock and key / Enzyme substrate complexes can form / substrate {fits / binds} into active site (1)	1		2

Question 4 · A level Component 2 · June 2025 · Q5(a)(ii) · 2 marks

	(ii)	• {N-acetyl and galactose / both substrates / they} have different {structures / shapes} (1) • The enzymes are specific to these shapes / different shape active sites / active sites are complementary (to substrates) (1)	1	1	2

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Question 5 · AS Component 2 · June 2016 · Q6(a)(i) · 3 marks

6	(a)	(i)	Any three (x1) from: 1. Reference to active site of α amylase/ lock and key hypothesis/ ref to enzyme substrate complexes (1) 2. complementary shape only to starch (not cellulose)(1) 3. Starch contains α glucose but cellulose contains β glucose/ reference to α bonds and β bonds (1) 4. Reference to {coiling in starch /straight chains in cellulose/ microfibrils in cellulose/ cross linking in cellulose / alternate (glucose) molecules rotated by 180^0 in cellulose/ molecules not rotated in starch (1)	3 3

Question 6 · AS Component 1 · June 2023 · Q1(b)(iii) · 4 marks

(iii)	Active site shape changes to fit the substrate (1) Enzyme-Substrate complex forms (1) Lowers activation energy (1) Active site returns to original shape after reaction (1)	4	4

Question 7 · AS Component 1 · June 2023 · Q1(b)(iv) · 2 marks

(iv)	Substrate complementary shape to active site (1) Reject perfect fit/match Active site does not change shape (1)	2	2

Question 8 · A level Component 1 · June 2019 · Q2(d) · 3 marks

(d)	A. Increased kinetic energy + {breaks hydrogen bonds/ denatures protein} (1) B. Holding together the specific (3-D) shape/ shape of active site changes (1) C. Protein can no longer carry out function/ enzyme- substrate complexes {can no longer form/ reduced} (1)	3	3

Question 9 · A level Component 3 · June 2024 · Q2(b) · 1 mark

(b)	vinegar {inactivates / denatures} enzyme / or description of change of shape of active site	1	1

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Question 10 · A level Component 2 · Autumn 2020 · Q3(b)(iii) · 2 marks

		(iii)		pH is 9 / alkaline + due to detergent (1) pepsin has optimum pH of 1 to 2 / acid (1) ORA Allow for 1 mark: pepsin not at optimal conditions (1)	

	2		2	2

Question 11 · A level Component 3 · Autumn 2020 · Q3(e)(i) · 1 mark

(e)	(i)	Both solutions reach the same temperature	1	1	1	

Question 12 · AS Component 1 · June 2017 · Q5(b)(ii) · 2 marks

(ii)	higher initial rate as {substrate/ DNA} is at {maximum/ higher} concentration (1) (therefore) higher rate of collisions/ more ES complexes formed/ owtte(1) Accept reverse argument / explanation for 0.5 minutes	2	2	

Question 13 · AS Component 1 · June 2024 · Q3(c)(ii) · 4 marks

	(ii)	**Any four (x1) from** A - As the concentration of enzyme increases, juice volume increases (1) B – {Above 0.6% / at 1%}the increase in volume is not as great / same volume (1) C - Increased successful collisions / increase E-S complexes formed (1) D - At low concentrations (there is lower volume due to) enzyme concentration being a limiting factor (1) E - At higher enzyme concentrations (0.6 – 1.0%), Pectin is (becoming) the limiting factor / not enough substrate / substrate all broken down (1)		2	2	4	1	4	

Question 14 · AS Component 1 · June 2016 · Q5(b) · 1 mark

(b)		Result depends on pH change in test tube so cannot change pH of experiment/ OWTTE e.g. acid pHs start colourless therefore cannot see change/ pH buffer would prevent changes in colour	1	1	1	

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Question 15 · A level Component 1 · June 2019 · Q4(a) · 2 marks

4	(a)	{ATP/ inhibitor} binds to {a site away from the active site/ a site other then the active site} (1) Changing the shape of the active site /Substrate no longer fits in active site (1)	2	2

Question 16 · A level Component 1 · Autumn 2020 · Q3(c) · 2 marks

(c)	ATP binds to allosteric site / to enzyme but not to active site (1) Changes shape of active site. (1)	2	2

Question 17 · A level Component 2 · June 2023 · Q4(e)(iii) · 3 marks

	(iii)	Binds {to a place on acrosin away from the active site/at allosteric site} (1) Changes the {shape/ structure} of the <u>active site</u> (1) Prevents it hydrolysing zona pellucida (1)	2 1	3

Question 18 · AS Component 1 · June 2016 · Q5(c) · 3 marks

(c)		**Any 3 from:** 1. Drug is a similar shape to the substrate/ complementary to active site (1) 2. Drug {binds to/ blocks/ occupies} the active site of the {enzyme/lipase}/ the {substrate/lipid} cannot enter active site/ forms enzyme inhibitor complex (1) 3. <u>Fewe</u>r enzyme substrate complexes/<u>less</u> lipid molecules are hydrolysed by the lipase/ <u>fewer</u> successful collisions (1)	3	3	

Question 19 · AS Component 1 · June 2016 · Q3(b) · 2 marks

(b)		**Any two (x1) from:** Only glucose will give a result/enzyme specific (to glucose) (1) Detects very low concentrations (1) Reading is more accurate /enzyme is more stable (1) Accept works at different temperatures	2		2

Question 20 · A level Component 1 · June 2025 · Q4(d)(i) · 2 marks

(d)	(i)	**Any two (x1) from:** • increased stability over wider range of {pH / temperature} / owtte (1) • can be reused (1) • specific (1)	2	2

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