Enzyme Concentration and Initial Rates (Core Practical 4): Edexcel SNAB A Level Biology Exam Questions

15 questions · 42 marks · about 50 minutes. Answer in the spaces, then check the mark schemes at the end.

Question 1 · information from earlier in the question

(b) One of the enzymes injected into the prey is called arazyme. Arazyme is a protease enzyme that can break down collagen.

Question 1 · AS Paper 1 · June 2017 · Q8(b)(ii) · 4 marks

(ii) The hydrolysis of collagen results in a decrease in pH. The indicator phenolphthalein is pink at pH 8 and becomes colourless at lower pH values.

Devise an investigation to determine the effect of arazyme concentration on the rate of hydrolysis of collagen.

(4)

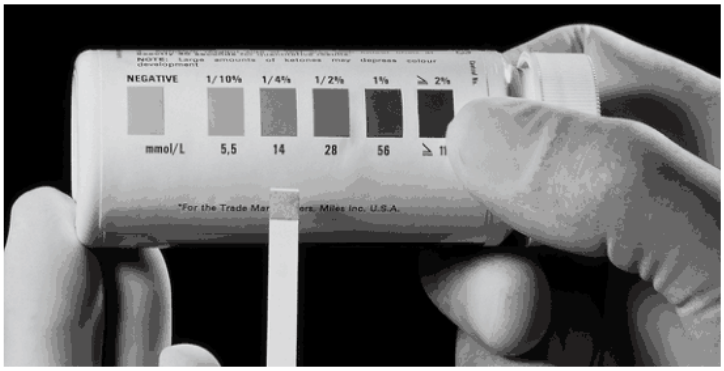
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Question 2 · AS Paper 1 · June 2022 · Q7(b) · 6 marks

(b) The effect of sucrose concentration on the initial rate of reaction was investigated.

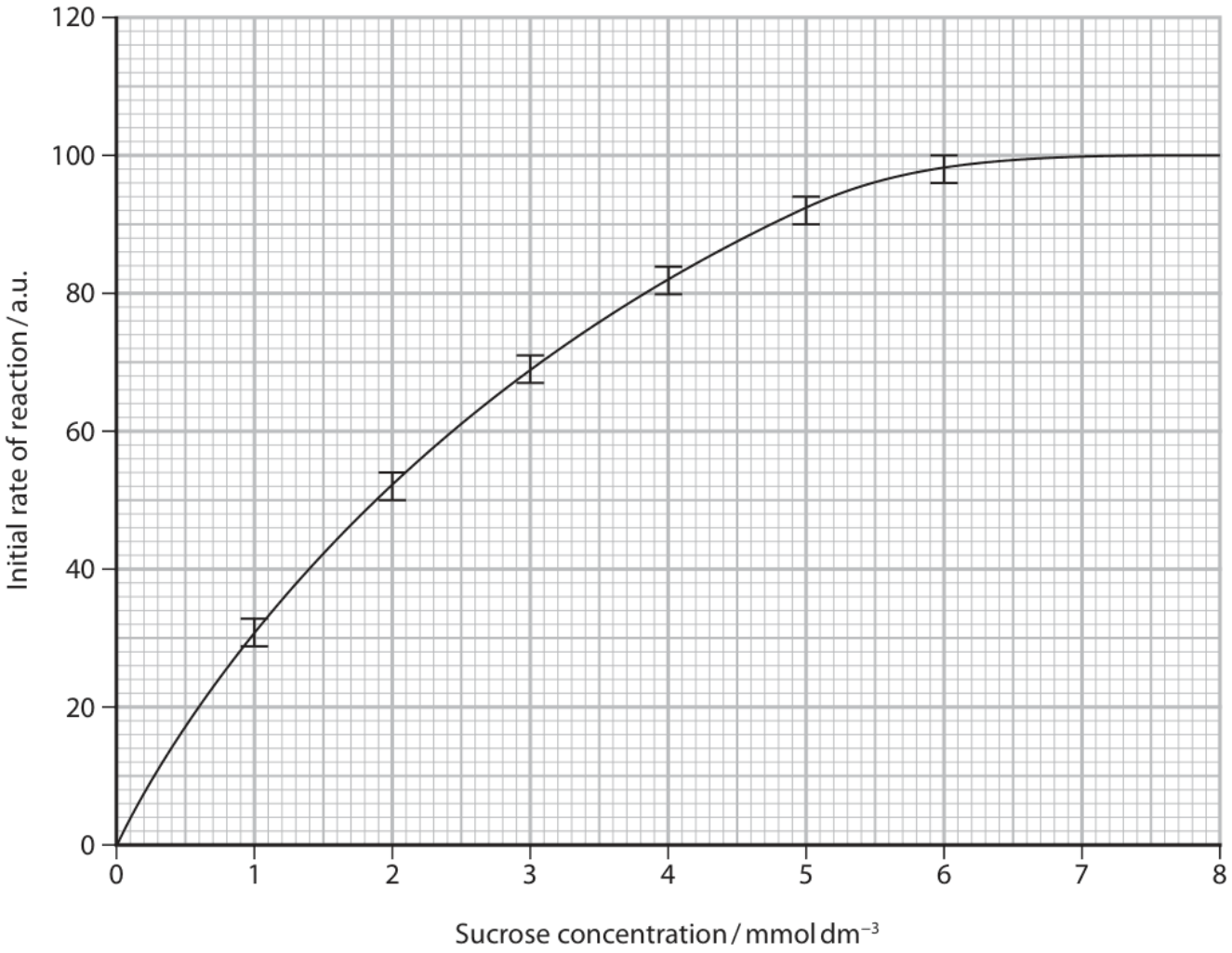
A solution containing 2% sucrase was added to sucrose solutions of different concentrations.

The photograph shows strips that can be used to test for glucose concentration.



(Source: © SATURN STILLS/SCIENCE PHOTO LIBRARY)

The graph shows the results of this investigation.



Explain how to carry out a valid investigation to collect the data shown in the graph.

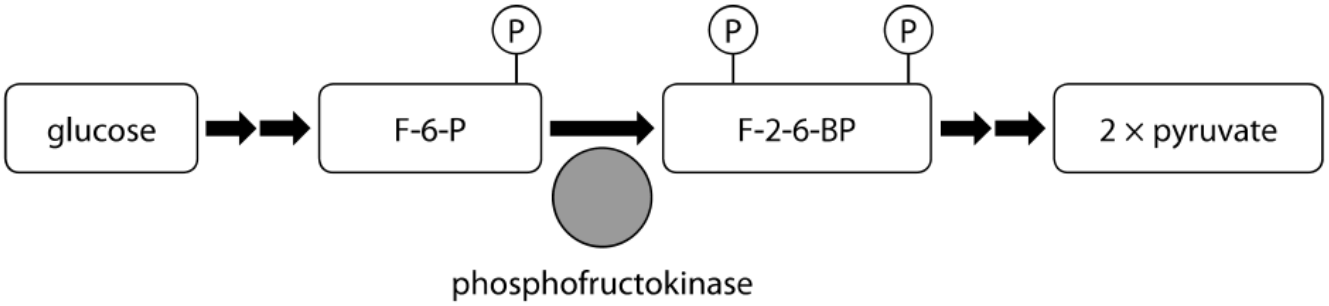
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Question 3 · information from earlier in the question

(b) Phosphofructokinase is an enzyme that uses ATP to convert fructose-6-phosphate (F-6-P) into fructose-2,6-bisphosphate (F-2,6-BP).

The conversion of F-6-P by this enzyme is a rate-determining step in glycolysis. This is shown in the diagram.

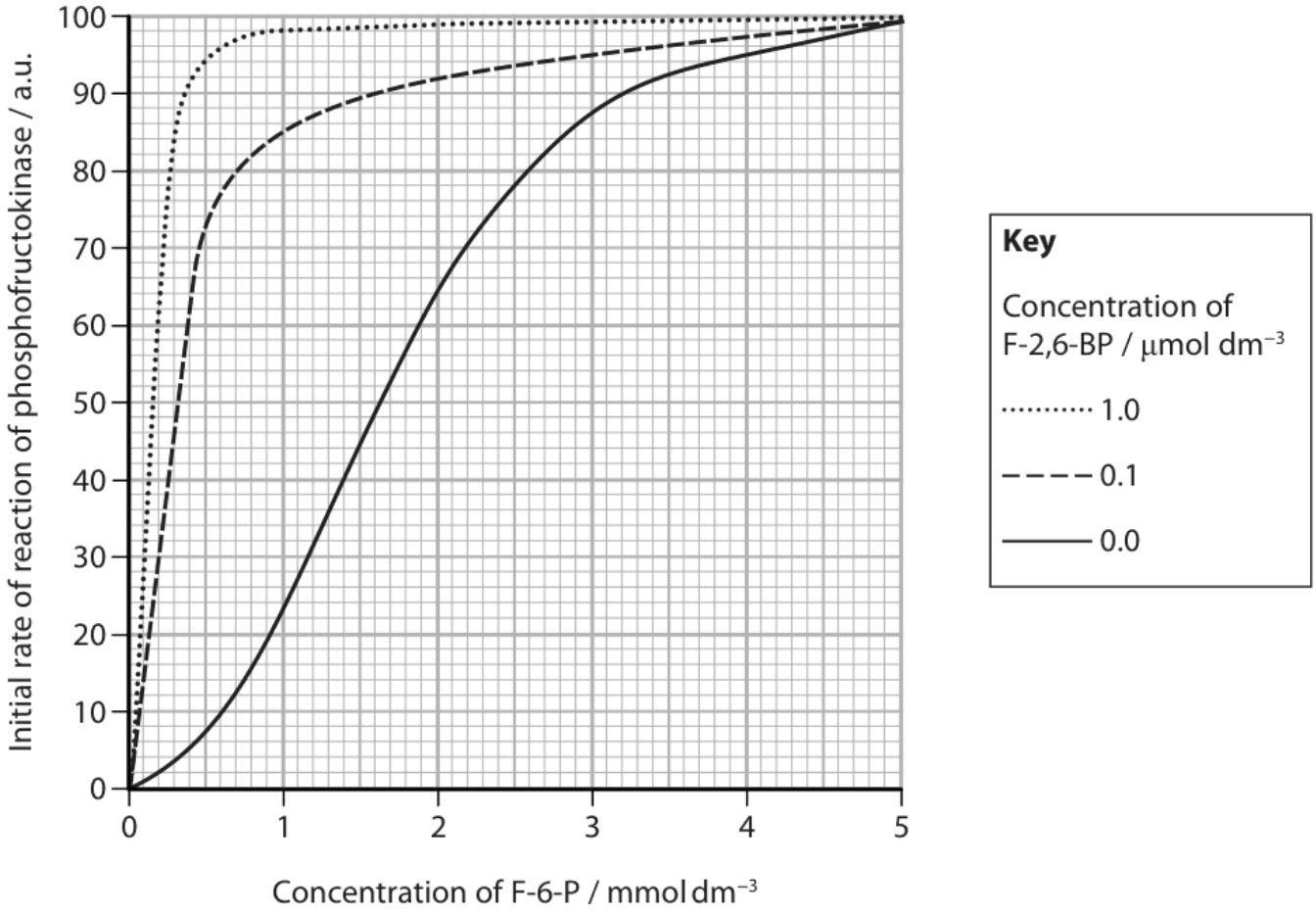


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(ii) The effect of substrate concentration on the initial rate of reaction of phosphofructokinase was investigated.

This investigation was repeated with the addition of two concentrations of F-2,6-BP.

The graph shows the results of this investigation.



Comment on the effects of F-6-P and F-2,6-BP concentrations on the rate of glycolysis.

(3)

Question 3 · A level Paper 3 · June 2019 · Q6(c) · 4 marks

(c) Glycolysis is inhibited by acidic conditions.

Devise an investigation to determine the effect of acidic conditions on the initial rate of reaction of phosphofructokinase.

(4)

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Question 4 · AS Paper 1 · November 2021 · Q7(a)(i) · 1 mark

7 Starch changes the colour of iodine solution from yellow-brown to blue-black.

The enzyme amylase hydrolyses starch.

The initial rate of reaction of starch hydrolysis was investigated.

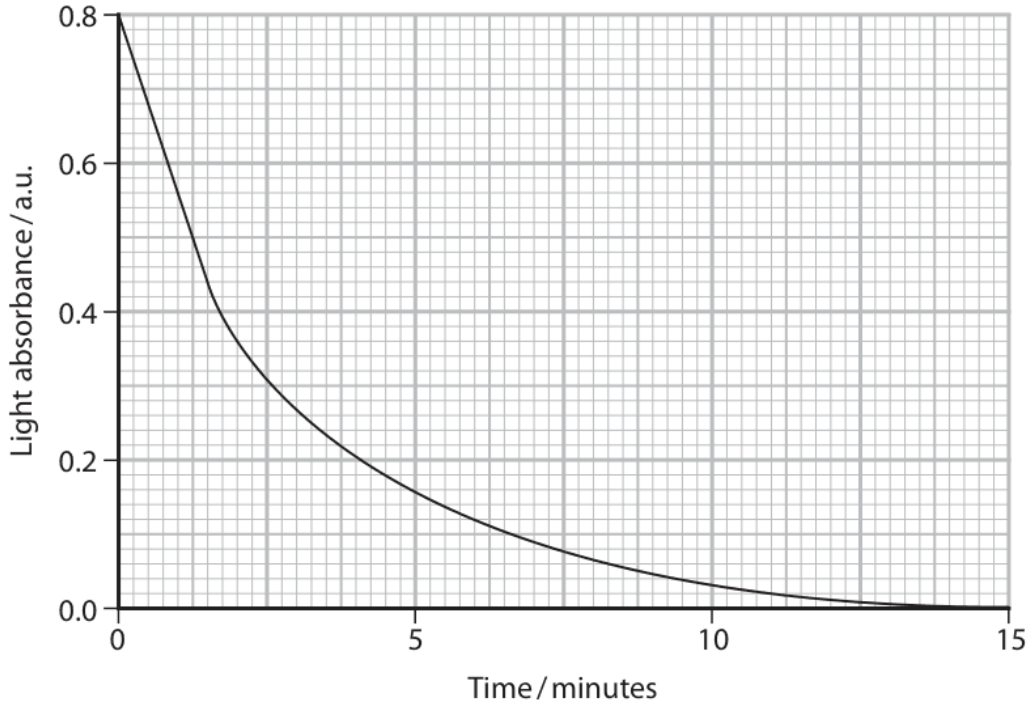
A test tube contained 25 cm^3 of starch suspension to which 1 cm^3 of 1% amylase solution was added.

A sample was immediately taken from this test tube and added to iodine solution.

The light absorbance of this mixture was measured.

This was repeated every 30 seconds during the investigation.

The results are shown in the graph.



(a) (i) Name a piece of apparatus that would be used to measure the light absorbance of this mixture.

(1)

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Question 5 · AS Paper 1 · November 2021 · Q7(b) · 3 marks

(b) Explain why the light absorbance of the mixture changed over time.

(3)

Question 6 · AS Paper 1 · November 2021 · Q7(a)(ii) · 3 marks

(ii) Calculate the initial rate of reaction for this experiment.

(3)

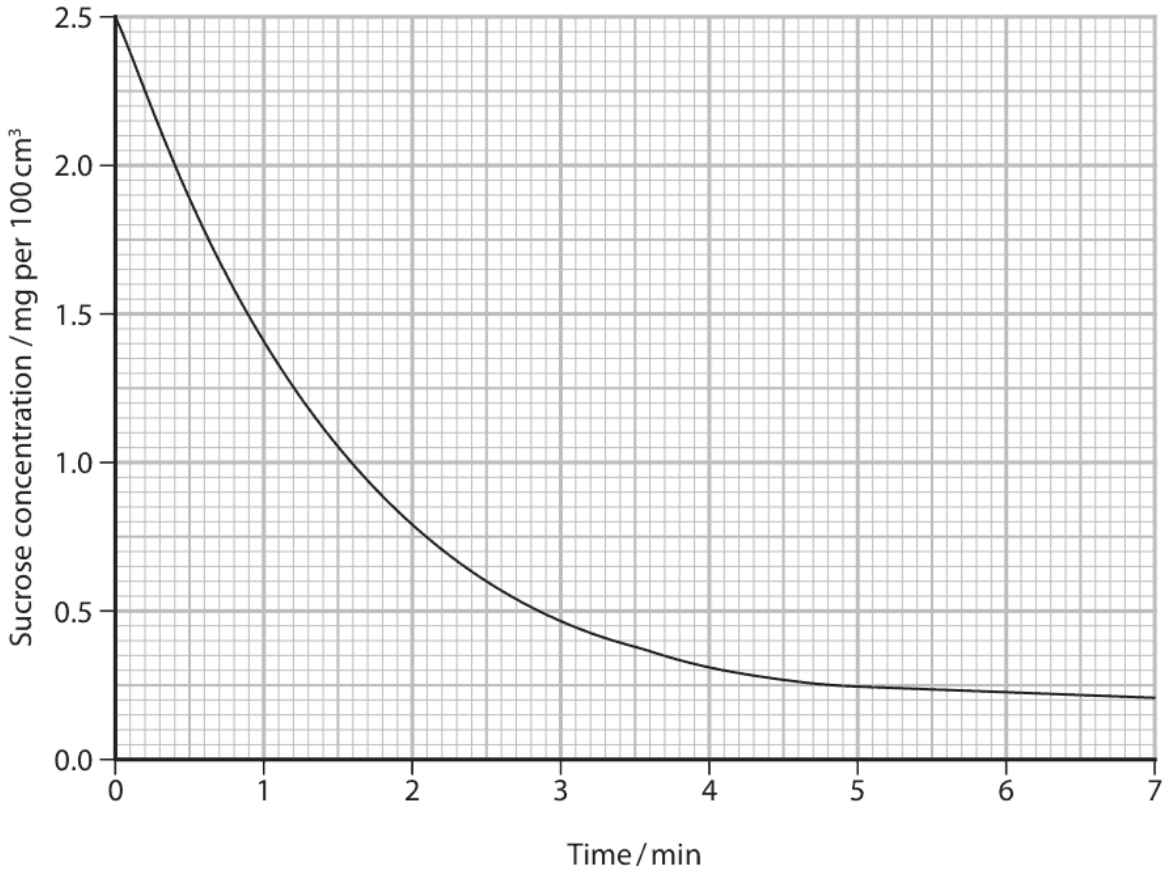
Answer .....

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Question 7 · AS Paper 1 · June 2022 · Q7(a) · 2 marks

7 The disaccharide sucrose is hydrolysed by the enzyme sucrase.

The graph shows the change in sucrose concentration in the presence of sucrase.



(a) Calculate the initial rate of reaction from this graph.

Give your answer to one decimal place.

(2)

..... mg per 100 cm^3 min^{-1}

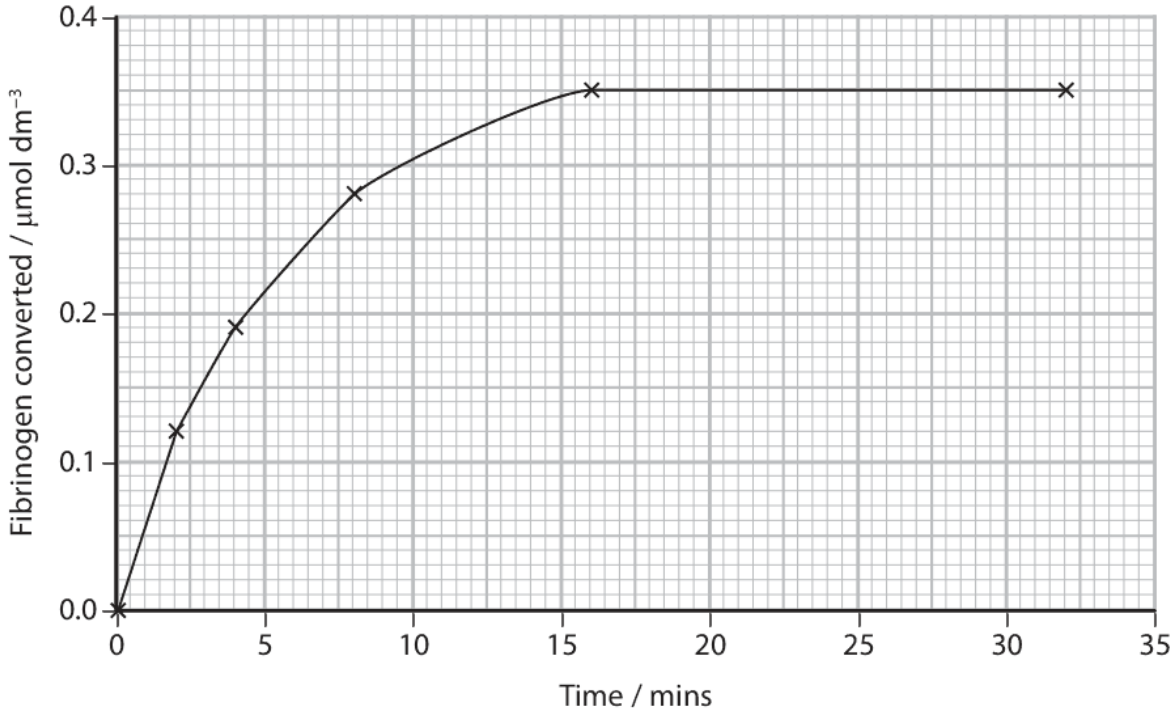
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Question 8 · A level Paper 1 · June 2017 · Q6(a)(i) · 2 marks

6 Fibrin is involved in the formation of blood clots.

Thrombin is an enzyme that converts fibrinogen to fibrin.

(a) The graph shows the effect of one concentration of thrombin on the conversion of fibrinogen to fibrin.



(i) Calculate the initial rate of reaction.

(2)

Answer .....

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Question 9 · AS Paper 1 · June 2025 · Q6(d)(ii) · 2 marks

(ii) Describe how the initial rate of reaction for collagenase could be calculated.

(2)

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Question 10 · information from earlier in the question

7 Starch changes the colour of iodine solution from yellow-brown to blue-black.

The enzyme amylase hydrolyses starch.

The initial rate of reaction of starch hydrolysis was investigated.

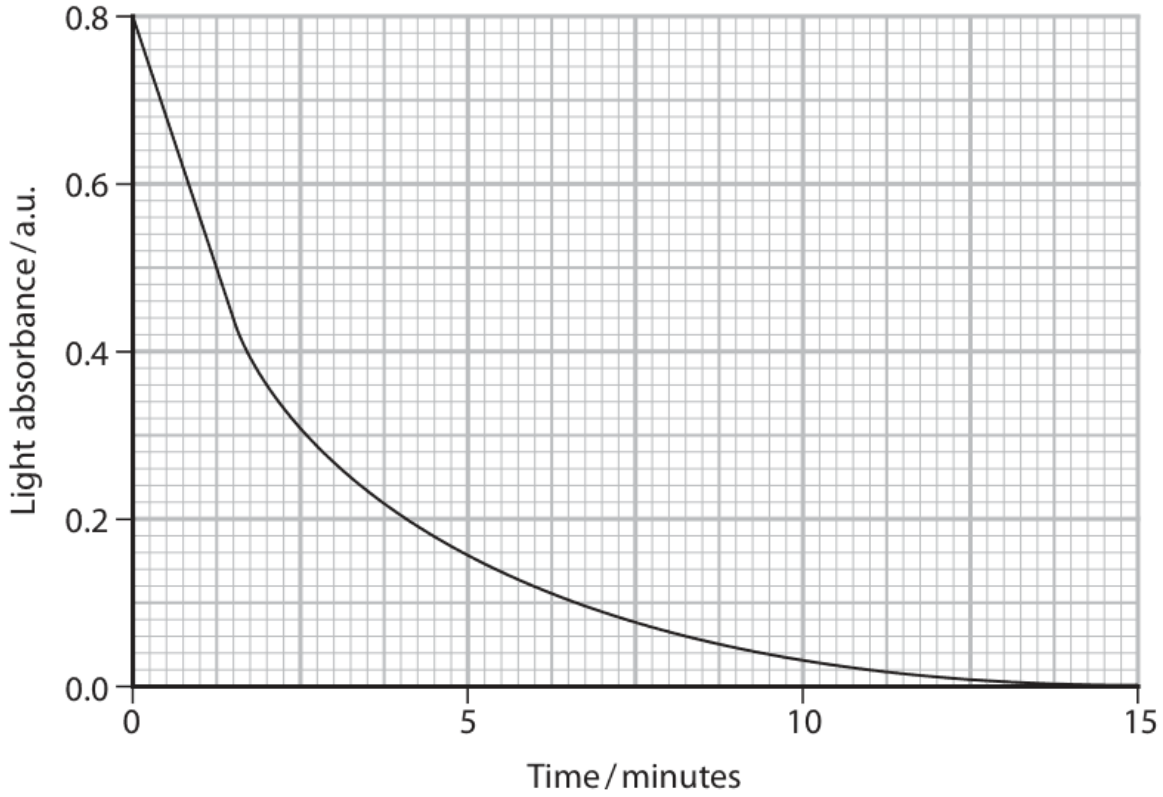
A test tube contained 25 cm^3 of starch suspension to which 1 cm^3 of 1% amylase solution was added.

A sample was immediately taken from this test tube and added to iodine solution.

The light absorbance of this mixture was measured.

This was repeated every 30 seconds during the investigation.

The results are shown in the graph.



Question 10 · AS Paper 1 · November 2021 · Q7(a)(iii) · 1 mark

(iii) Draw a line on the graph to show the expected trend if a 5% amylase solution was used instead.

(1)

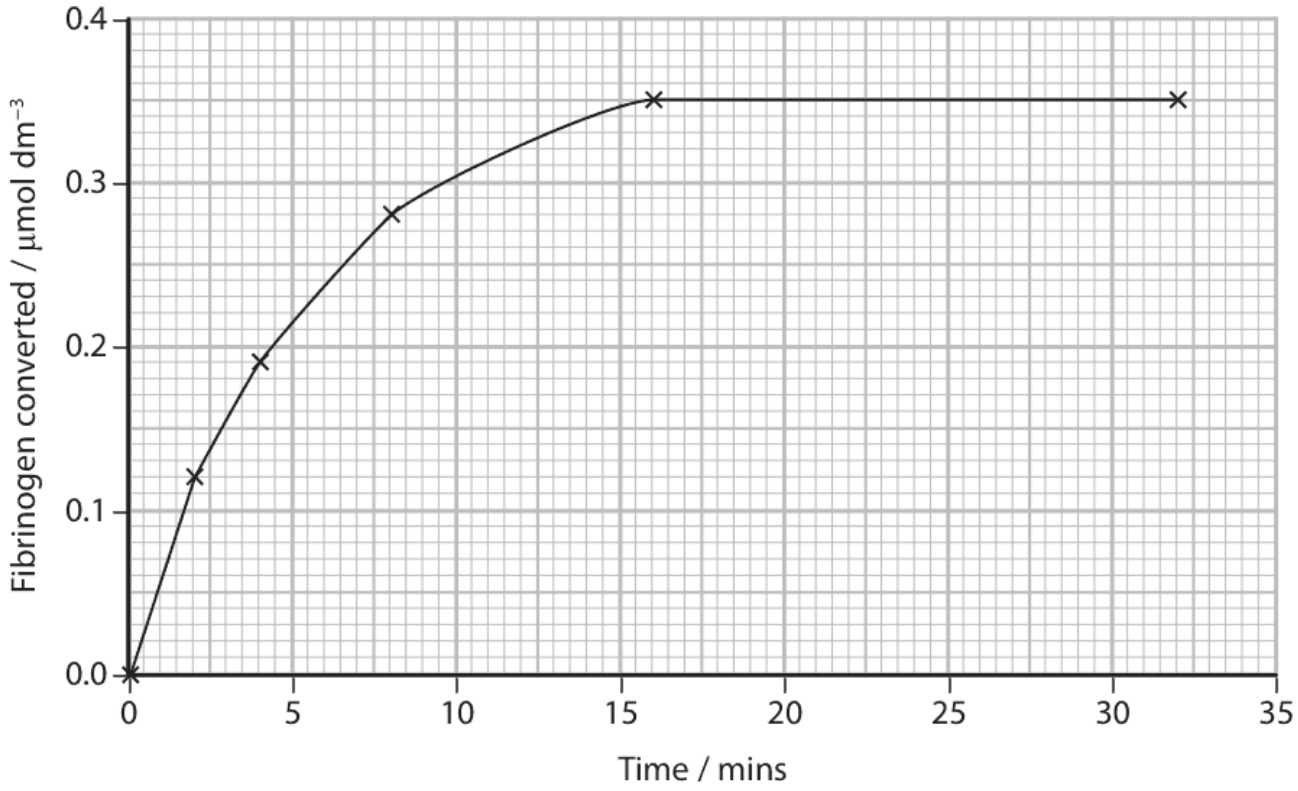
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Question 11 · information from earlier in the question

6 Fibrin is involved in the formation of blood clots.

Thrombin is an enzyme that converts fibrinogen to fibrin.

(a) The graph shows the effect of one concentration of thrombin on the conversion of fibrinogen to fibrin.



Question 11 · A level Paper 1 · June 2017 · Q6(a)(ii) · 1 mark

(ii) On the graph, draw a line to show the effect of halving the concentration of thrombin.

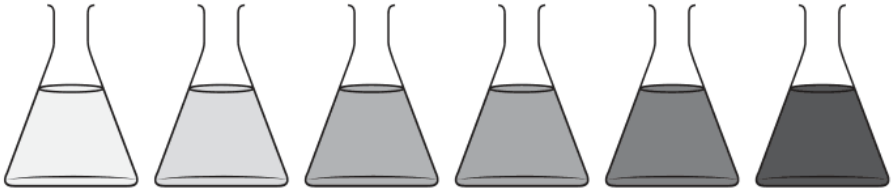
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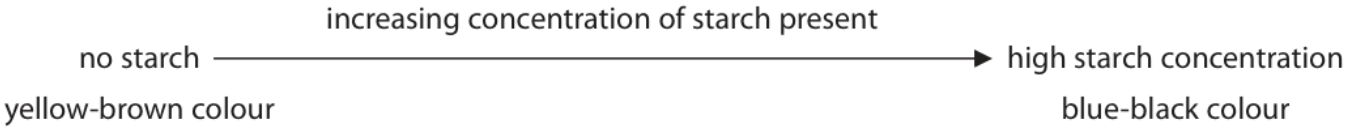
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Question 12 · information from earlier in the question

(b) Amylase breaks down starch into maltose.

The diagram shows the effect of adding iodine to flasks containing different concentrations of starch.





The effect of amylase concentration on the rate of reaction, at two different temperatures, was investigated.

The table shows the results of this investigation.

Enzyme concentration / mmol dm^{-3}	Rate of reaction at 30 °C / a.u.	Rate of reaction at 45 °C / a.u.
0	0	0
1	31	16
2	41	25
3	69	36
4	82	42
5	92	47
6	98	54
7	100	62
8	100	70

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Question 12 · AS Paper 1 · June 2024 · Q6(b)(ii) · 4 marks

(ii) Comment on the effects of enzyme concentration and temperature in this investigation.

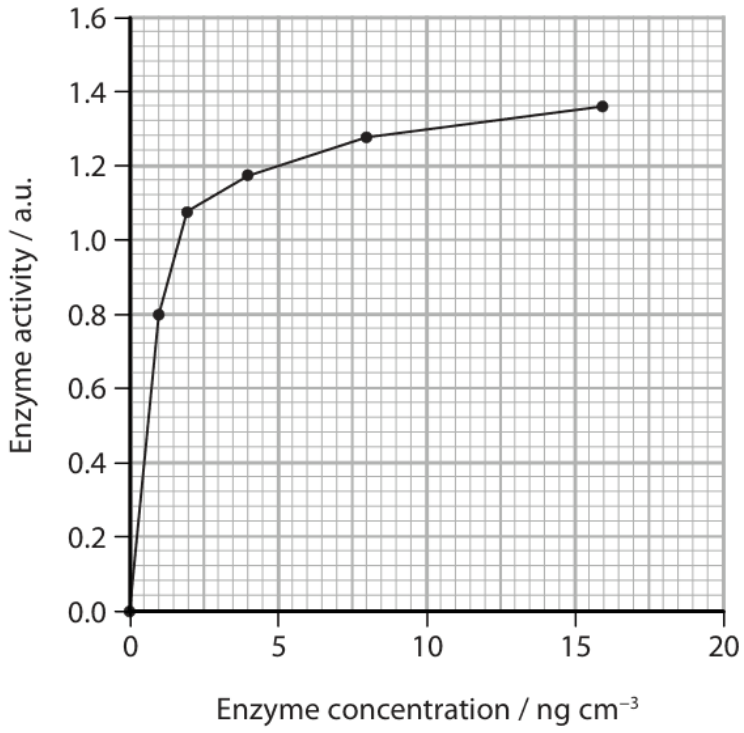
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Question 13 · A level Paper 1 · June 2018 · Q8(d) · 2 marks

(d) In an experiment, the effect of enzyme concentration on the activity of human trypsin was measured.

The results are shown in the graph.



Explain which range of enzyme concentrations should be used to compare the activity of trypsin from different species.

(2)

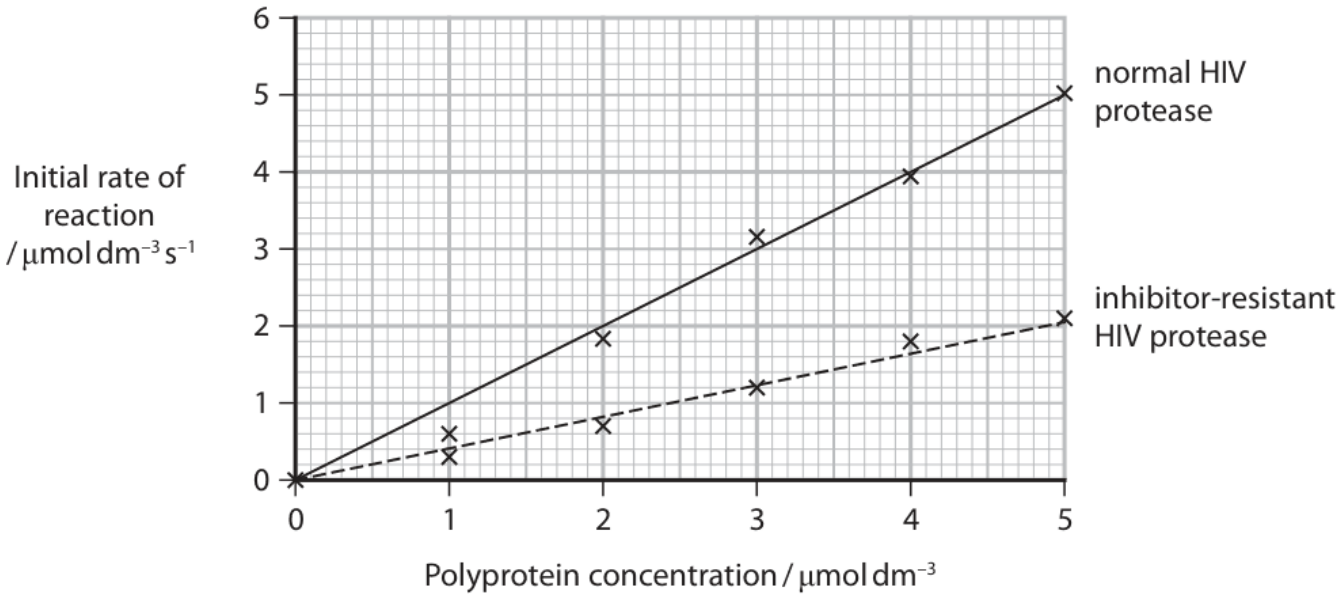
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Question 14 · information from earlier in the question

(c) HIV protease inhibitors are used in drugs to treat HIV infection.

In some individuals, the HIV has developed resistance to protease inhibitors.

The graph shows the effect of polyprotein concentration on the initial rate of reaction of normal HIV protease and inhibitor-resistant HIV protease.



Question 14 · A level Paper 3 · June 2024 · Q5(c)(ii) · 3 marks

(ii) Explain the importance of enzyme and substrate concentrations when comparing the initial rates of reaction of different enzymes.

(3)

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Question 15 · AS Paper 1 · June 2017 · Q8(c) · 4 marks

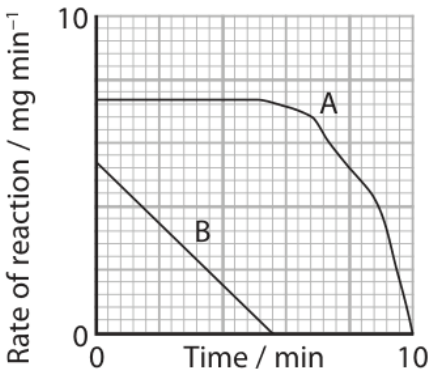
(c) The effect of substrate concentration on the rate of an enzyme reaction was investigated.

Two substrate solutions, A and B, were used. Solution A had a higher concentration than solution B. The optimum pH for the enzyme was pH 7.

The product lowered the pH of the solution.

The rate of reaction was determined at 1-minute intervals for 10 minutes.

The graph shows the results of this investigation.



It was concluded that the product reduces the activity of the enzyme.

Comment on the validity of this conclusion.

(4)

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Mark schemes

Question 1 · AS Paper 1 · June 2017 · Q8(b)(ii) · 4 marks

Question Number	Answer
8 (b)(ii)	An answer that makes reference to the following: • at least five different concentrations of arazyme solution (1) • a controlled variable (1) • measuring of the dependent variable (1) • time taken (for phenolphthalein) to decolourise (1) • {replicates / repeats} for each arazyme concentration to allow calculation of mean values (1)

Additional Guidance	Mark
ALLOW 0% arazyme e.g. volume of enzyme / volume of substrate / concentration of substrate / temperature / volume of indicator e.g. colorimeter / compare to colour standard	**(4)**

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Question 2 · AS Paper 1 · June 2022 · Q7(b) · 6 marks

Question Number	Answer
7(b)	An answer that makes reference to six of the following: • range of at least five sucrose concentrations used between 1 and 8 (mmol dm^{-3}) (1) • volumes of sucrase and sucrose solutions controlled (1) • detail of how another relevant variable could be controlled (1) • method to detect glucose presence (1) • method to determine glucose concentration (1) • description of how initial rate calculated (1)

Additional Guidance	Mark
e.g. use of water bath, buffers to control pH, 2% sucrase e.g. use of indicator strip or Benedict's reagent e.g. standardise test strip colour / refer to chart for indicator strip / convert colour into concentration	**(6)**

8BN0_01 QPEC Version

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Question 3 · A level Paper 3 · June 2019 · Q6(c) · 4 marks

Question Number	Answer
6(c)	An answer the makes reference to four of the following: • use pH buffers at a range of pH values below 7 (1) • provide an excess of ATP (1) • (use) F-6-P at an appropriate concentration (1) • suitable variable controlled (1) • measure quantity of F-2,6-BP produced per unit time (1)

Additional guidance	Mark
e.g. 2 mmol dm^{-3} (values between 1 and 2.5 mmol dm^{-3}) e.g. {enzyme / phosphofructokinase } concentration / temperature ALLOW measure change in concentration of F-2,6-BP / phosphate incorporated	**(4)**

Question 4 · AS Paper 1 · November 2021 · Q7(a)(i) · 1 mark

Question Number	Answer	Additional Guidance	Mark
7 (a)(i)	colorimeter	DO NOT ACCEPT calorimeter	**(1)**

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Question 5 · AS Paper 1 · November 2021 · Q7(b) · 3 marks

Question Number	Answer	Additional Guidance	Mark
7 (b)	An explanation which makes reference to the following: • light absorbance decreased (1) • (because) starch hydrolysed by {amylase / enzyme} (1) • (therefore) iodine solution stays yellow-brown colour (1)	ALLOW amylase broke down starch ALLOW less light absorbed by yellow-brown / more light absorbed by blue-black ALLOW converse for transmission of light	**(3)**

8BN0_01 QPEC Version

Question 6 · AS Paper 1 · November 2021 · Q7(a)(ii) · 3 marks

Question Number	Answer	Additional Guidance	Mark
7 (a)(ii)	• correct calculation of change in absorbance during initial stage of reaction (1) • correct calculation of (initial) rate of reaction (1) • correct answer with units (1)	Example of calculation e.g. 0.8- 0.5 = 0.3 0.3 ÷ 75= 0.004 0.004 au s^{-1} / 0.24 au min^{-1} ALLOW ecf for correct calculation using incorrect figures ALLOW '/ s' , '/ min' , 'per second' or 'per minute' for units if answer correct	**(3)**

8BN0_01 QPEC Version

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Question 7 · AS Paper 1 · June 2022 · Q7(a) · 2 marks

Question Number	Answer
7(a)	• correct subtraction of values read from graph (1) • correct calculation of initial rate of reaction (1)

Additional Guidance	Mark
Example of calculation (2.5-1.85±0.05) = 0.65 ±0.05 = 1.2 or 1.3 Full marks for correct answer with no working.	(2)

Question 8 · A level Paper 1 · June 2017 · Q6(a)(i) · 2 marks

Question Number	Answer	Additional Guidance	Mark
6(a)(i)	• correct values taken from the graph (1) • correct answer with correct units (1)	Example of calculation 0.12 ÷ 2 = = 0.06 μmol dm^{-3} min^{-1} = 0.06 μmol per dm^3 per minute or = 0.001 μmol dm^{-3} s^{-1} = 0.001 μmol per dm^3 per second Correct answer with no units gains one mark Correct answer with correct units but no working gains full marks	2

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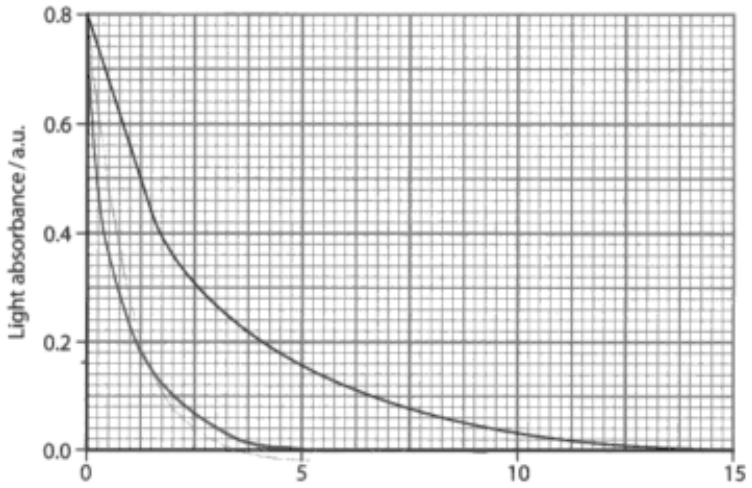
Question 9 · AS Paper 1 · June 2025 · Q6(d)(ii) · 2 marks

Question Number	Answer
6(d)(ii)	A description that makes reference to two of the following: • add a set volume of collagenase to an excess of collagen (1) • measure {concentration of collagen/ products of collagen breakdown} at regular time intervals (1) • {determine gradient of slope / draw a tangent} at time zero (1)

Additional Guidance	Mark
ALLOW calculate mass of collagen broken down in (first) {30 seconds / 1 minute} and divide by the time ALLOW calculate g/s at start of the line	(2)

Question 10 · AS Paper 1 · November 2021 · Q7(a)(iii) · 1 mark

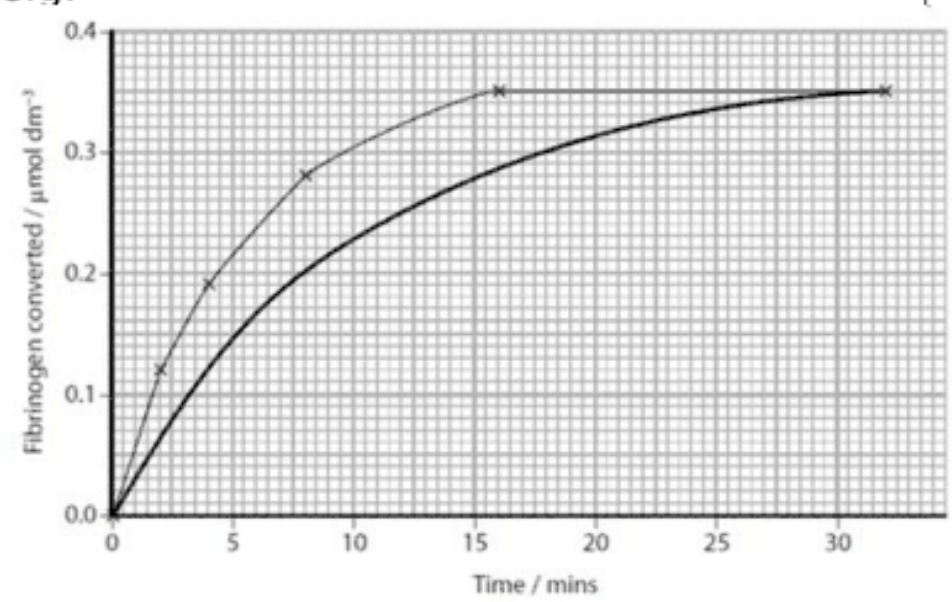
Question Number	Answer
7 (a)(iii)	line with same starting and finishing position but showing a faster decrease in light absorbance / y=0 at less than 13 minutes (1)

Additional Guidance	Mark
Example of line:  	(1)

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Question 11 · A level Paper 1 · June 2017 · Q6(a)(ii) · 1 mark

Question Number	Answer
6(a)(ii)	• curve that is less steep but reaches the same plateau (1)

Additional Guidance	Mark
e.g. 	1

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Question 12 · AS Paper 1 · June 2024 · Q6(b)(ii) · 4 marks

Question Number	Answer
6(b)(ii)	An answer which makes reference to four of the following: • the rate of reaction increases as concentration increases (1) • enzymes had a higher rate of reaction at 30°C (than at 45°C) (1) • the rate of reaction is lower at 45°C (than 30°C) because {it is above the optimum temperature for amylase / (some of) the enzyme has denatured} (1) • {at higher enzyme concentration / 30°C} more enzyme-substrate complexes form (1) • at 30°C the rate of reaction plateaus (at 100 a.u. / 7 mmol dm^{-3}) due to a named limiting factor (1)

Additional Guidance	Mark
ALLOW piece together ALLOW converse ALLOW optimum temperature closer to 30°C than 40°C ALLOW the active site of the enzyme has {been affected / changed shape} at the higher temperature ALLOW {at lower enzyme concentration / 45°C} fewer enzyme-substrate complexes form e.g. substrate concentration	**(4)**

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Question 13 · A level Paper 1 · June 2018 · Q8(d) · 2 marks

Question Number	Answer	Additional Guidance	Mark
8(d)	An explanation that makes reference to two of the following: • use a range of concentrations between 0 and 2.0 (ng cm^{-3}) (1) • so that enzyme concentration is the only limiting factor (1) • because the initial rates of reaction have to be compared (1)		**(2)**

Question 14 · A level Paper 3 · June 2024 · Q5(c)(ii) · 3 marks

Question number	Answer
5(c)(ii)	An answer that makes reference to the following: • substrate concentration should be {in excess / not limiting} (1) • so that enzyme works at its maximum rate (1) • concentrations of different enzymes should be the same to allow a comparison (1)

Additional guidance	Mark
ALLOW enzyme and substrate concentrations should be the same (in each experiment) to allow comparison (of different enzymes)	Choose an item. (3)

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Question 15 · AS Paper 1 · June 2017 · Q8(c) · 4 marks

Question Number	Answer	Additional Guidance	Mark
8 (c)	An answer that makes reference to the following: • the conclusion is not valid (1) • as pH would reduce faster {at higher substrate concentrations / in graph A} (1) • (however) rate of reaction for A did not decrease immediately (1) • lower pH would result in the denaturation of the enzyme and reduction in the rate of reaction (1)	ALLOW the product does not reduce the activity of the enzyme ALLOW converse for solution B ALLOW more product is produced in solution A, but the rate of reaction decreases slower than in solution B ALLOW converse for solution B	**(4)**

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