

PEARSON EDEXCEL A-LEVEL BIOLOGY B • 9B10

BIOLOGY



EXAM QUESTION PACK

TOPIC 1: BIOLOGICAL MOLECULES
CORE PRACTICAL 1

SCORE

/48

PERCENTAGE

%

STEMUP

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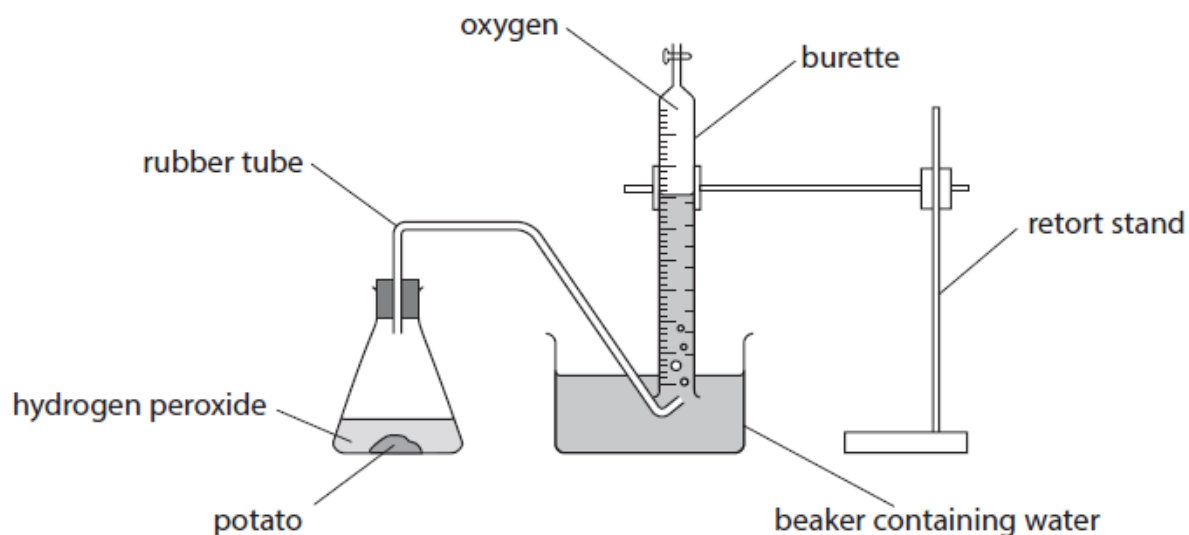
Q1.

The activity of enzymes is affected by a number of factors.

A student investigated the activity of the enzyme catalase in potato.

This enzyme is found in potato cells. It catalyses the conversion of hydrogen peroxide to oxygen and water.

The diagram shows the apparatus used to collect the data.



(i) Describe how two named variables, other than the potato, can be controlled in order to obtain valid results.

(4)

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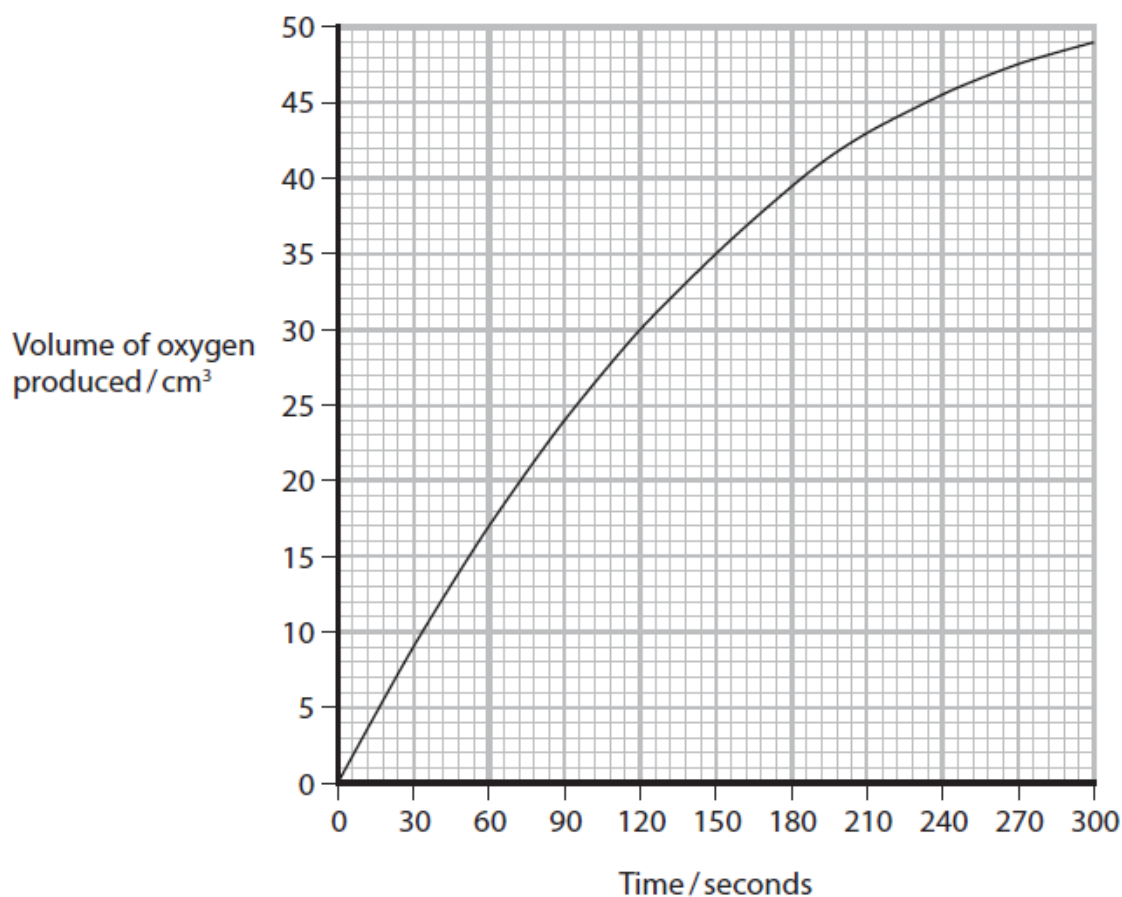
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(ii) The graph shows the results of the investigation.



Determine the initial rate of reaction from this graph.

(1)

Answer

(iii) Explain why the rate of reaction decreases over time.

(2)

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(Total for question = 7 marks)

Q2.

Glucose and fructose are monosaccharides.

The makers of sweet tasting drinks use the enzyme glucose isomerase to convert glucose into fructose.

Fructose is a monosaccharide that tastes much sweeter than glucose.

(i) Explain a possible health benefit of converting glucose into fructose for use in sweet tasting drinks.

(2)

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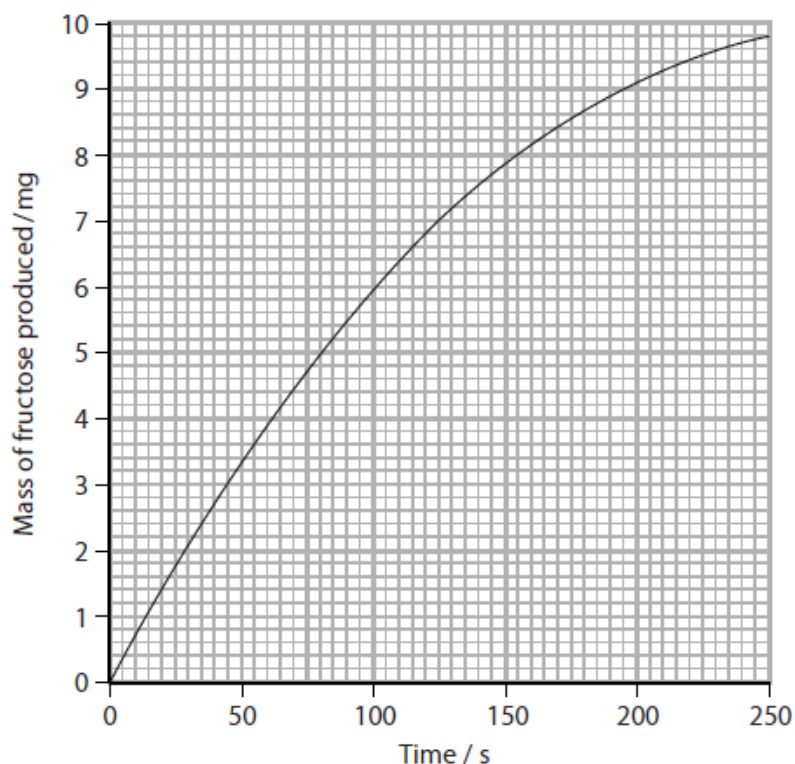
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(ii) A student investigated the activity of glucose isomerase.

The graph shows the results of this investigation.



Determine the initial rate of the reaction.

(1)

Answer

(iii) Cofactors are non-protein molecules that help enzymes to function.

Magnesium ions act as cofactors for some enzymes.

Devise an experiment to investigate the effect of magnesium ions on the initial rate of this reaction.

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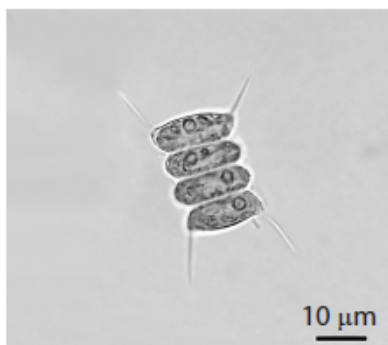
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(Total for question = 8 marks)

The green alga, *Scenedesmus quadricauda*, lives in fresh water. Each cell has a single chloroplast.

The photograph shows some *Scenedesmus* cells.



Photosynthesis can be measured if these algae are placed in a solution containing hydrogen carbonate indicator.

When the carbon dioxide concentration is the same as that of atmospheric air, the hydrogen carbonate indicator is red.

As the carbon dioxide concentration decreases, the hydrogen carbonate indicator changes colour from red to pink and then to purple.

A student investigated the effect of light on the rate of photosynthesis in *S. quadricauda*.

He used different coloured filters to vary the wavelength of the light.

The algae were added to a solution of hydrogen carbonate indicator in a test tube.

The test tube was sealed and placed under a lamp with a red filter.

After 30 minutes, the student noted the colour of the hydrogen carbonate indicator.

He then shook the open test tube until the indicator returned to its original colour.

He repeated this procedure with yellow, green and blue filters, using the same algae and the same indicator solution.

The student's results are shown in the table.

colour of filter	wavelength of light / nm	colour of indicator after 30 minutes
red	640	reddish pink
yellow	580	pink
green	520	pinky purple
blue	460	dark purple

(i) Analyse the data to explain what conclusion may be drawn from these results.

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(ii) The student repeated the method using fresh hydrogen carbonate indicator and a new sample of *S. quadricauda*.

This time he used the blue filter first, then green, then yellow, then red.

The results are shown in the table.

colour of filter	wavelength of light / nm	colour of indicator after 30 minutes
blue	460	reddish pink
green	520	pink
yellow	580	pinky purple
red	640	dark purple

*Evaluate the student's investigation.

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Q4.

An investigation was carried out to determine the effect of substrate concentration on the initial rate of an enzyme-controlled reaction.

The substrate used was powdered milk, which is made up of a protein called casein.
A solution of powdered milk is a cloudy white colour.

Protease enzymes will break down the casein in powdered milk to form a clear solution.

A colorimeter can be used to measure the amount of light absorbed by a solution in a tube. A cloudy solution absorbs more light.

5 cm³ of 0.1% solution of powdered milk was added to a colorimeter tube and mixed with 0.1 cm³ of a protease enzyme. The mixture was quickly placed in the colorimeter and the absorption of the solution was then recorded every 10 seconds for 30 seconds.

This was then repeated using different concentrations of casein.

(a) Explain why it is important to measure the initial rate of enzyme-catalysed reactions.

(3)

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(b) A student carrying out this investigation recorded the data shown in the table below.

Casein concentration (%)	Absorption (arbitrary units)			
	0 s	10 s	20 s	30 s
0.1	0.15	0.10	0.05	0.05
0.2	0.44	0.34	0.23	0.15
0.3	0.67	0.49	0.32	0.16
0.4	0.87	0.65	0.43	0.22
0.5	0.98	0.75	0.52	0.26

(i) Explain why using all of the absorption data from every concentration of casein would not give a valid comparison of initial rates.

(2)

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(ii) Explain how the results obtained could be used in the design of an investigation to compare the activity of proteases from different mammals.

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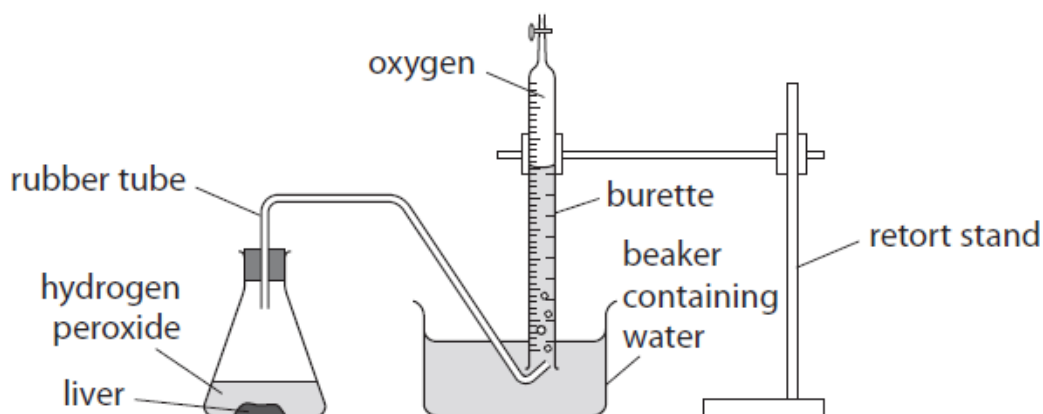
(Total for question = 7 marks)

Q5.

Liver cells contain an enzyme called catalase.

This enzyme changes hydrogen peroxide in the liver cells into water and oxygen.

A group of students used the apparatus shown to compare the activity of catalase in raw liver tissue and in boiled liver tissue.



The students used the following method.

- a burette filled with water is placed in a beaker containing water
- add hydrogen peroxide to the conical flask
- open the conical flask and drop 0.1g of raw liver into the hydrogen peroxide
- replace the bung on the conical flask
- after 10 seconds pinch the rubber tube to stop any more oxygen entering the burette
- measure the volume of oxygen collected in the burette
- repeat this method for boiled liver

The table shows the results obtained by each student.

Student	Volume of oxygen collected in 10 seconds / cm ³	
	Raw liver	Boiled liver
1	19	0
2	40	0
3	28	0
4	38	0
5	42	0
6	29	0
7	34	0
8	46	0
9	38	0

The results for the volume of oxygen collected by each student using raw liver were different.

Give **four** possible improvements to the method used by these students that would reduce the variability of the results.

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(Total for question = 4 marks)

Q6.

Cysteine proteases are enzymes found in fruits such as pineapples.

When a protease enzyme is added to fat-free skimmed milk, the milk turns from cloudy to clear.

Devise an investigation to find the optimum temperature for the activity of the enzyme cysteine protease found in pineapples.

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(Total for question = 6 marks)

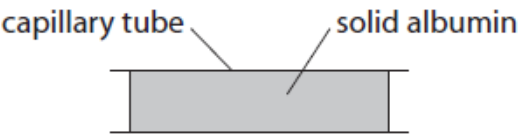
Q7.

The egg of a hen contains albumin, a globular protein.

Pepsin is an enzyme that digests albumin.

Albumin can be put into a 50 mm long capillary tube and then made solid by boiling in water for 10 minutes.

The diagram shows a 50 mm capillary tube containing solid albumin.



Devise an investigation into the effect of pepsin concentration on the digestion of solid albumin.

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(Total for question = 5 marks)

Mark Scheme

Q1.

Question Number	Answer	Additional Guidance	Mark
(i)	An answer including two of the following variables with suitable methods of control: • appropriate named variable (1) • description of how the variable is controlled (1) • appropriate named second variable (1) • description of how second variable is controlled (1)	eg • volume of hydrogen peroxide / accept stated volume - measuring cylinder / syringe / pipette (to measure same volume) • concentration of hydrogen peroxide / accept stated concentration - dilute / make up solution to same % concentration / use of stock solution • temperature / accept stated temp - flask in thermostatically controlled waterbath / accept descriptions • pH / accept stated pH - buffer in flask	Exp (4)

Question Number	Answer	Additional Guidance	Mark
(ii)	Initial rate of reaction calculated (1)	Answer uses seconds $0.33 \text{ cm}^3 \text{ s}^{-1}$ Accept: values in range: $0.28 \text{ to } 0.35 \text{ cm}^3 \text{ s}^{-1}$ Accept: cm^3/s : cm^3 per second Answer uses minutes $19.8 \text{ cm}^3 \text{ min}^{-1}$ Accept: values in range $16.8 \text{ to } 21.0 \text{ cm}^3 \text{ min}^{-1}$ Accept: cm^3/min : cm^3 per min	Grad (1)

Question Number	Answer	Additional Guidance	Mark
(iii)	An explanation including the following {hydrogen peroxide / substrate} is {converted to products / used up} (1) - so less substrate to collide with the enzyme (1)	Accept {hydrogen peroxide / substrate} becomes a limiting factor Accept concentration of {hydrogen peroxide / substrate} decreases Accept less substrate so fewer enzyme-substrate complexes form	Exp (2)

Q2.

Question Number	Answer	Additional Guidance	Mark
(i)	An answer that makes reference to two of the following: - less needed for same sweet effect (1) - therefore less {energy / calorie} intake (1) - therefore less risk of appropriate named health benefit (1)	e.g. reduced obesity / (type 2) diabetes / tooth decay / heart disease / atherosclerosis / high blood pressure / CVD / CHD	(2)

Question Number	Answer	Additional Guidance	Mark
	0.066 to 0.074	DO NOT ACCEPT 0.06°	(1)

Question Number	Answer	Additional Guidance	Mark
(iii)	An answer that makes reference to the following: • with and without magnesium ions (1) • use same {volume / stated cm^3 / concentration} of isomerase enzyme (1) • use excess {glucose / substrate} (1) • control {temperature / pH} (1) • repeat to {calculate mean / calculate average / standard deviation / standard error / recognise anomalies} (1)	ACCEPT same mass DO NOT ACCEPT if in list	(5)

Q3.

Question Number	Acceptable Answer	Additional Guidance	Mark
(i)	An explanation that makes reference to the following: • (as) wavelength of light decreases, rate of photosynthesis increases (1) • because the data show a greater colour change at shorter wavelengths of light, indicating faster CO_2 uptake (by alga) (1)	ACCEPT converse throughout	(2)

Question Number	Indicative content
* (ii)	Answers will be credited according to candidate's deployment of knowledge and understanding of the material in relation to the qualities and skills outlined in the generic mark scheme. The indicative content below is not prescriptive and candidates are not required to include all the material which is indicated as relevant. Additional content included in the response must be scientific and relevant. - the trend of the results is opposite in the two repeats: results are not reliable - variables such as organism and indicator are controlled whereas variables such as temperature and light intensity are not controlled - colour changes judged by eye are qualitative and not precise - fastest rate is seen with the last filter used, therefore temperature may be responsible for change in rate - experiment left for 30 minutes, other additional times would give extra information about the rate - coloured indicator may affect the wavelengths of light reaching the algae - the algae will be respiring and producing CO₂, which complicates measurement of the rate of photosynthesis - rate of respiration is assumed to be constant, but this may not be the case - changes in temperature or pH may alter the activity of the enzymes responsible for photosynthesis - conclusion that the experiment is invalid / not measuring effect of wavelength on photosynthesis

Level	Marks	Descriptor
Level 0	0	No awardable content
Level 1	1-3	Limited scientific judgement made with a focus on mainly one aspect. A few strengths or weaknesses identified. A conclusion may be attempted, demonstrating isolated elements of biological knowledge and understanding but supported with limited evidence.
Level 2	4-6	Scientific judgements are made through the application of relevant evidence, referring to both methods and trends in results. Both strengths and weaknesses are identified. A conclusion is made with reference to more than one piece of evidence, demonstrating links to biological knowledge and understanding.
Level 3	7-9	Scientific judgements are made through detailed analysis and interpretation of relevant evidence including trends in results and several aspects of methodology. Both strengths and weaknesses are identified in both methods and results. A conclusion is made, demonstrating sustained linkages to biological knowledge and understanding and drawing upon several strands of evidence.

Q4.

Question Number	Correct Answer	Additional guidance	Mark
(a)	An explanation that makes reference to the following: - initial concentration of casein will change quickly (1) - because enzymes cause large increase in reaction rates (1) - therefore only initial rate will measure the speed of reaction at the correct value of the independent variable/concentration of casein (1)	Active site occupation Substrate becomes limiting	(3)

Question Number	Correct Answer	Additional guidance	Mark
(b)(i)	An explanation that makes reference to the following: - absorption has not decreased for 0.1% from 20 s to 30 s/reaction has stopped after 20 s/substrate has been used up (1) - but all other concentrations show a consistent change every 10 s for the whole 30 s (1)		(2)

Question Number	Correct Answer	Additional guidance	Mark
(b)(ii)	An explanation that makes reference to the following: - an appropriate casein concentration chosen because substrate is not limiting (1) - absorption recorded in first 20s in order to obtain initial rates (1)		(2)

Q5.

Question Number	Answer	Mark
	An answer that makes reference to four of the following: - use liver with same surface area to volume ratio (1) - control temperature (1) - control {volume / concentration} of hydrogen peroxide (1) - replace bung quickly (1) - use gas syringe to collect oxygen (1)	(4)

Q6.

Question Number	Answer	Additional Guidance	Mark
	An answer that makes reference to six of the following: • make extract of pineapple juice (1) • same {volume of skimmed milk / volume of pineapple juice extract} (1) • {use colorimeter to measure changes in absorbance with time / beaker over a black cross and time to disappear} (1) • calculation of initial rate (1) • at a range of temperatures using a water bath (1) • pH controlled using buffer (1) • plot graph of initial rate against temperature (1)	Allow other appropriate methods Allow use colorimeter to measure transmission Allow measure absorbance every 30s Allow 10 – 80°C (must be at least 5 temps)	(6)

Q7.

Question Number	Answer	Additional Guidance	Mark
	An answer that makes reference to five of the following: • (put albumin tubes into a) range of at least five pepsin concentrations (1) • control {temperature using water bath / pH using buffer} (1) • use same {concentration / source / mass / length / volume} of albumin (1) • leave for {same / stated} time or measure at regular time intervals (1) • measure {length of albumin remaining / mass of albumin} (at end of investigation) (1) • {use several capillary tubes / repeat} and {calculate mean / calculate SD / identify anomalies} (1) • control tube with no enzyme (for comparison) (1)	Time how long it takes for albumin to disappear = 2 marks Accept measure absorbance using a colorimeter	(5)