

PEARSON EDEXCEL A-LEVEL BIOLOGY B • 9B10

BIOLOGY



EXAM QUESTION PACK

TOPIC 1: BIOLOGICAL MOLECULES
ENZYMES

SCORE

/100

PERCENTAGE

%

STEMUP

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Q1.

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

Explain why increasing the temperature of an enzyme-controlled reaction changes the rate of reaction.

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(Total for question = 3 marks)

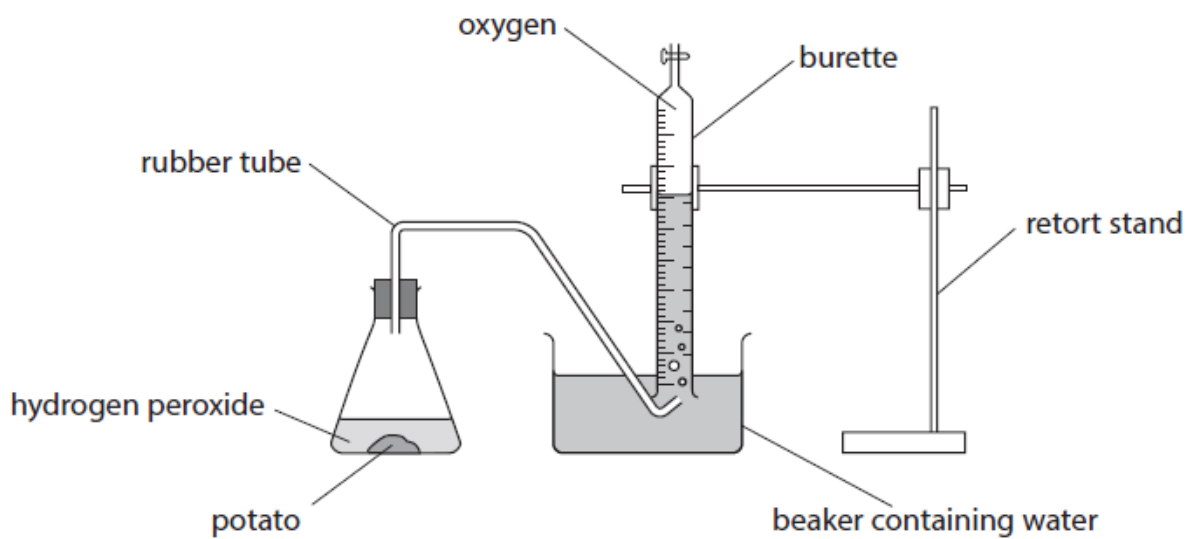
Q2.

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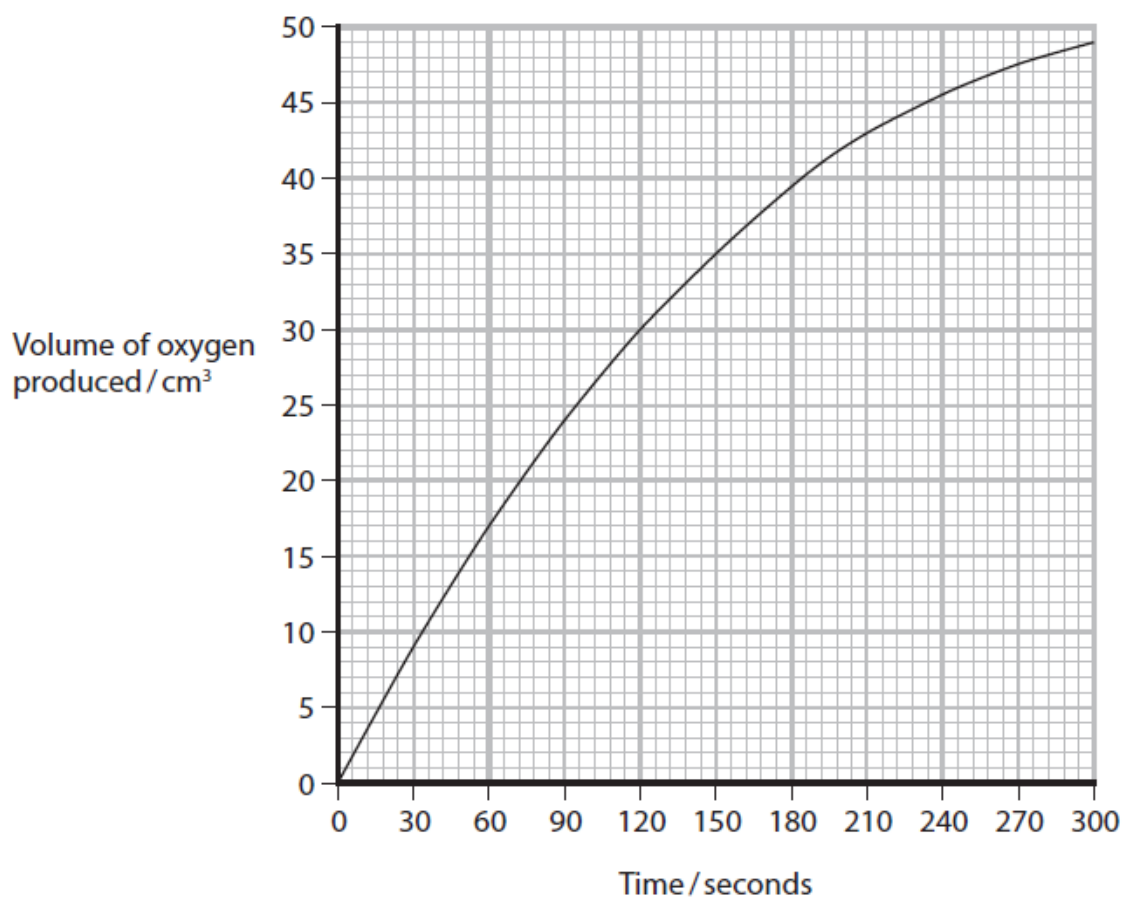
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(ii) The graph shows the results of the investigation.



Determine the initial rate of reaction from this graph.

(1)

Answer

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

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(Total for question = 7 marks)

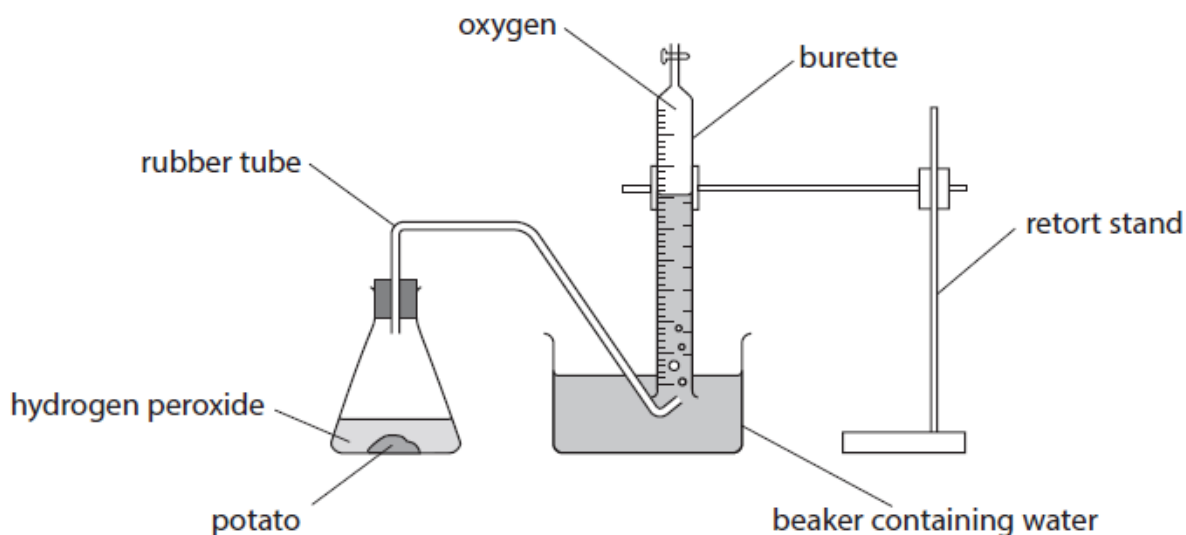
Q3.

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.



The student used this apparatus to investigate the effect of using increasing numbers of potato cubes on the rate of reaction.

The potato was cut into 1 cm^3 cubes to be used in five trials.

In the first trial, one cube was added to the flask and the volume of oxygen produced in 30 seconds was measured.

The hydrogen peroxide was then replaced.

This was repeated in the other four trials using 2, 3, 4 and 5 cubes of potato.

Explain the results you would expect from this investigation.

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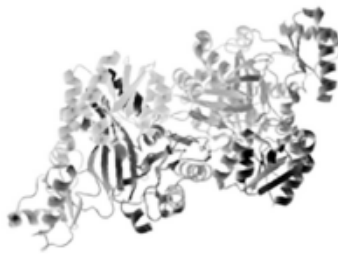
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(Total for question = 3 marks)

Q4.

Acetyl CoA is produced in the link reaction when pyruvate is broken down.

The photograph shows a molecule of the enzyme acetyl CoA carboxylase.



This enzyme is involved in the conversion of acetyl CoA into fatty acids.

The enzyme is activated by citrate.

Citrate does not bind at the active site.

Citrate is produced in the Krebs cycle.

The enzyme is inhibited by long chain fatty acyl CoA molecules.

Fatty acyl CoA molecules have a longer carbon chain than acetyl CoA.

(i) Analyse the information to explain how the activity of the enzyme acetyl CoA carboxylase is controlled.

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(ii) Explain why inhibitors of this enzyme may be useful in treating obesity in humans.

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(Total for question = 7 marks)

Q5.

A student planned to keep two species of fish in an aquarium.

One species of fish should be kept at a minimum temperature of 25 °C. The other species requires a minimum concentration of oxygen of 7.5 mg dm⁻³ water.

Explain why the student chose to keep these two species of fish in an aquarium at 30 °C.

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(Total for question = 4 marks)

Q6.

Skin flora include bacteria that live on the skin.

Different parts of the body have different types of bacteria present.

Skin flora are beneficial as they inhibit the growth of pathogenic bacteria on the skin.

Skin flora compete for nutrients and space or secrete toxic chemicals.

The following are types of bacteria found in the female genital tract:

- *Escherichia coli*
- *Klebsiella species*
- *Lactobacillus species*
- *Staphylococcus species*.

(i) Describe how these types of bacteria present in the female genital tract could be identified.

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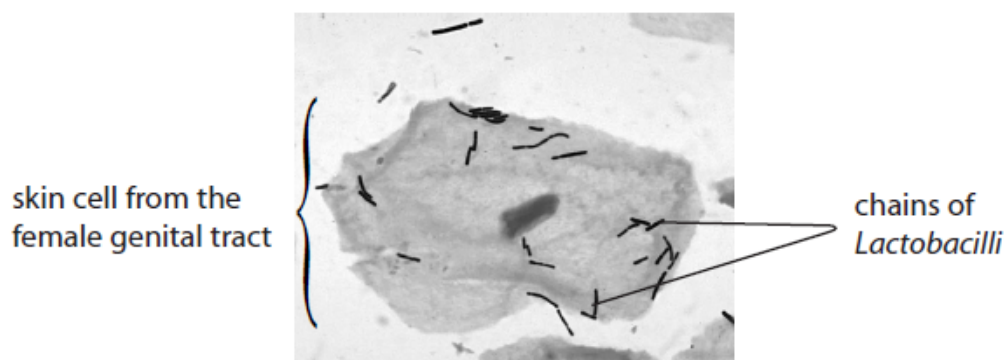
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(ii) The photograph shows *Lactobacilli* on a skin cell from the female genital tract.



Source: © Janice Carr Content Providers (s): CDC/Dr. Mike Miller

Lactobacilli metabolise glycogen into lactic acid.

Explain how *Lactobacilli* inhibit the growth of pathogenic bacteria in the female genital tract.

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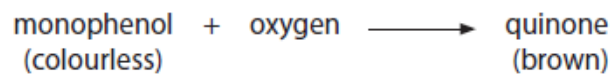
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(Total for question = 7 marks)

Q7.

Polyphenol oxidase is an enzyme found in many plant cells.

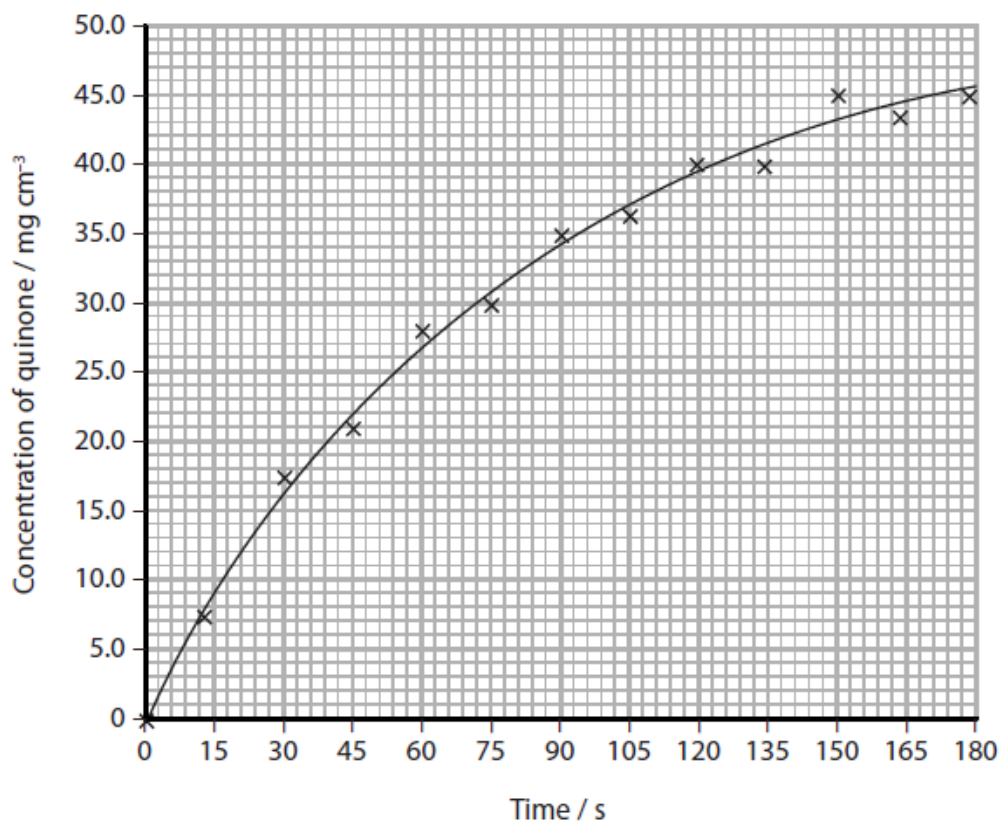
This enzyme catalyses the following reaction



This reaction causes cut fruit to turn brown when exposed to air.

A student carried out an investigation into the rate at which grape juice produced quinone.

The graph shows the results of this investigation.



(i) Calculate the initial rate of this reaction.

(3)

Answer

(ii) Explain why adding citric acid to cut fruit reduces the rate at which the fruit turns brown.

(2)

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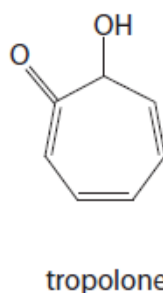
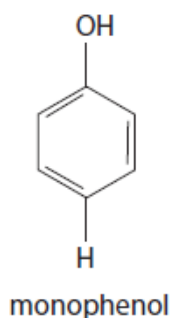
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(iii) The diagram shows the structures of monophenol and a molecule called tropolone.

Tropolone can be added to grape juice to slow the rate at which the juice turns brown.



Explain how tropolone affects the rate at which the grape juice turns brown.

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(Total for question = 7 marks)

Q8.

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.

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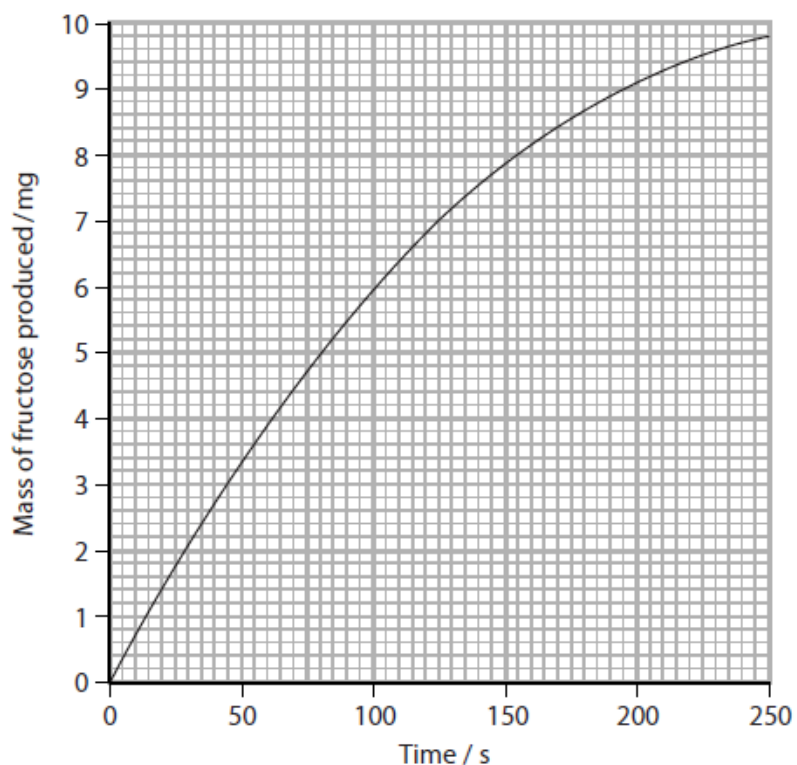
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(ii) A student investigated the activity of glucose isomerase.

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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(Total for question = 8 marks)

Q9.

Fungi break down dead plant and animal material in ecosystems.

Some types of fungi produce cellulase enzymes. These enzymes break down cellulose.

The breakdown of cellulose can be detected using Benedict's solution.
This solution turns red if monomers from the breakdown of cellulose are present.

Metal ions sometimes inhibit the activity of enzymes.

This inhibition occurs even if the metal ion concentration is low and the substrate concentration is high.

(i) Name the type of inhibition involved.

(1)

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(ii) Devise an experiment to test whether copper ions (Cu^{2+}) inhibit cellulase activity.

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Q10.

Answer the question with a cross in the box you think is correct ☒. If you change your mind about an answer, put a line through the box ~~☒~~ and then mark your new answer with a cross ☒.

The photographs show a black cat and a Siamese cat.

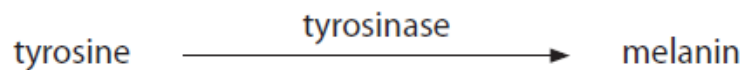


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© BSIP Laurent/Gluck/Science photo library

The pigment melanin causes the fur to turn black.
This pigment is produced by tyrosinase, an enzyme coded by the TYR gene.



Siamese cats have a mutation in their TYR gene.
This changes the secondary and tertiary structures of tyrosinase.

(i) Which of the following shows the type of bonding involved in both the secondary and tertiary structures of a protein?

(1)

- ☒ **A** hydrogen only
- ☒ **B** hydrogen and ionic
- ☒ **C** ionic and disulfide
- ☒ **D** ionic only

(ii) Explain why the cooler regions of a Siamese cat have dark coloured fur and the warmer regions have lighter coloured fur.

(3)

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(Total for question = 4 marks)

Q11.

Enzymes are polymers. A mutation in DNA can lead to a change in the primary structure of an enzyme.

Explain why a mutation might lead to a change in the activity of an enzyme.

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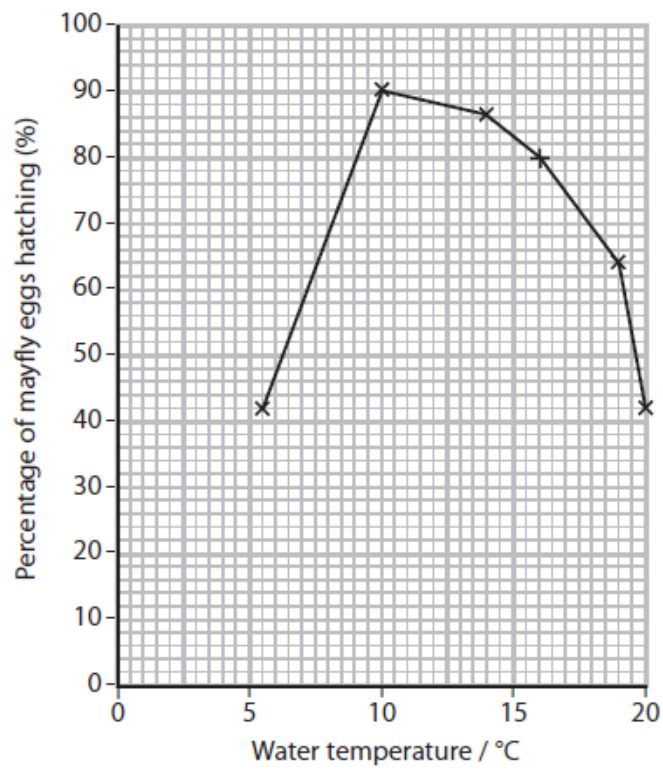
Q12.

The photograph shows an adult mayfly.



Mayflies lay their eggs in water.

The graph shows the effect of water temperature on the percentage of mayfly eggs that hatch.



Explain the effect of temperature on the percentage of mayfly eggs that hatch.

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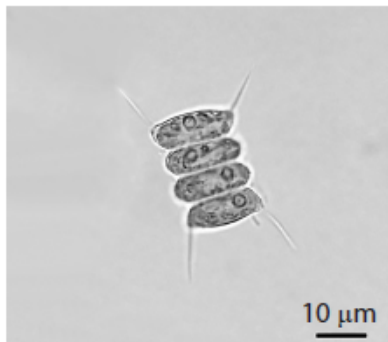
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(Total for question = 4 marks)

Q13.

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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Q14.

Hydrogen cyanide gas is a poison that can kill an animal if it is inhaled.

Cyanide is a non-competitive inhibitor of the enzyme cytochrome oxidase.

Cytochrome oxidase is the last carrier in the electron transport chain.

(i) Explain why hydrogen cyanide gas can kill an animal.

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(ii) A dose of 1.0 mg of hydrogen cyanide per kilogram of body mass is fatal.

An animal with a body mass of 10 kg inhaled air containing 0.24 mg dm^{-3} of hydrogen cyanide.

The animal breathed at a rate of 15 dm^3 of air per minute.

Calculate how many minutes it would take for this animal to obtain a fatal dose.

Give your answer to three significant figures.

(3)

Answer minutes

(Total for question = 8 marks)

Q15.

Enzymes are involved in the breakdown of carbohydrates.

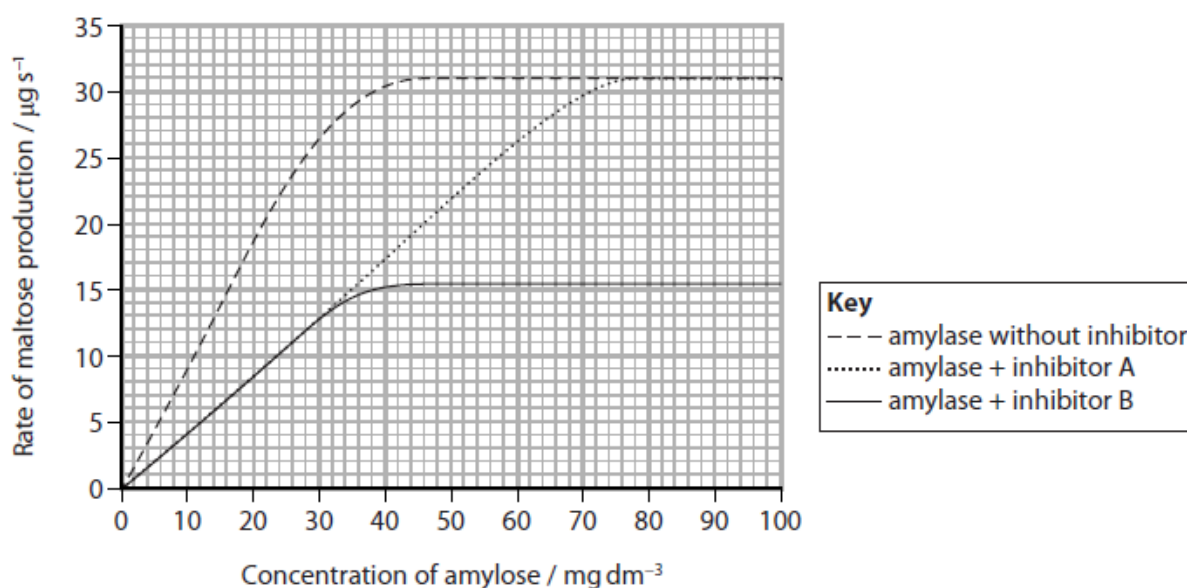
Some plants produce amylase inhibitors.

A student investigated the effects of two inhibitors, A and B, on the activity of amylase.

The same concentration of amylase and the same concentrations of the inhibitors A and B were used.

The rate of maltose production was measured at different concentrations of amylose with each inhibitor and without an inhibitor.

The results are shown in the graph.



(i) Compare and contrast the effects of these two inhibitors on amylase activity.

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(ii) Explain which of the two inhibitors is non-competitive.

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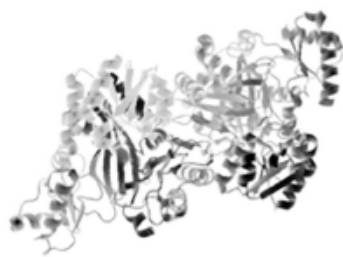
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(Total for question = 5 marks)

Q16.

Acetyl CoA is produced in the link reaction when pyruvate is broken down.
The photograph shows a molecule of the enzyme acetyl CoA carboxylase.



This enzyme is involved in the conversion of acetyl CoA into fatty acids.
The enzyme is activated by citrate.

Citrate does not bind at the active site.

Citrate is produced in the Krebs cycle.

The enzyme is inhibited by long chain fatty acyl CoA molecules.

Fatty acyl CoA molecules have a longer carbon chain than acetyl CoA.

The enzyme acetyl CoA carboxylase has a different structure in bacteria.

The enzyme in bacteria is made of several polypeptide subunits whereas in humans, the enzyme is one large polypeptide.

Inhibitors of the bacterial enzyme are being developed to treat bacterial infections.

Explain why inhibitors of the bacterial enzyme may be useful when treating bacterial infections.

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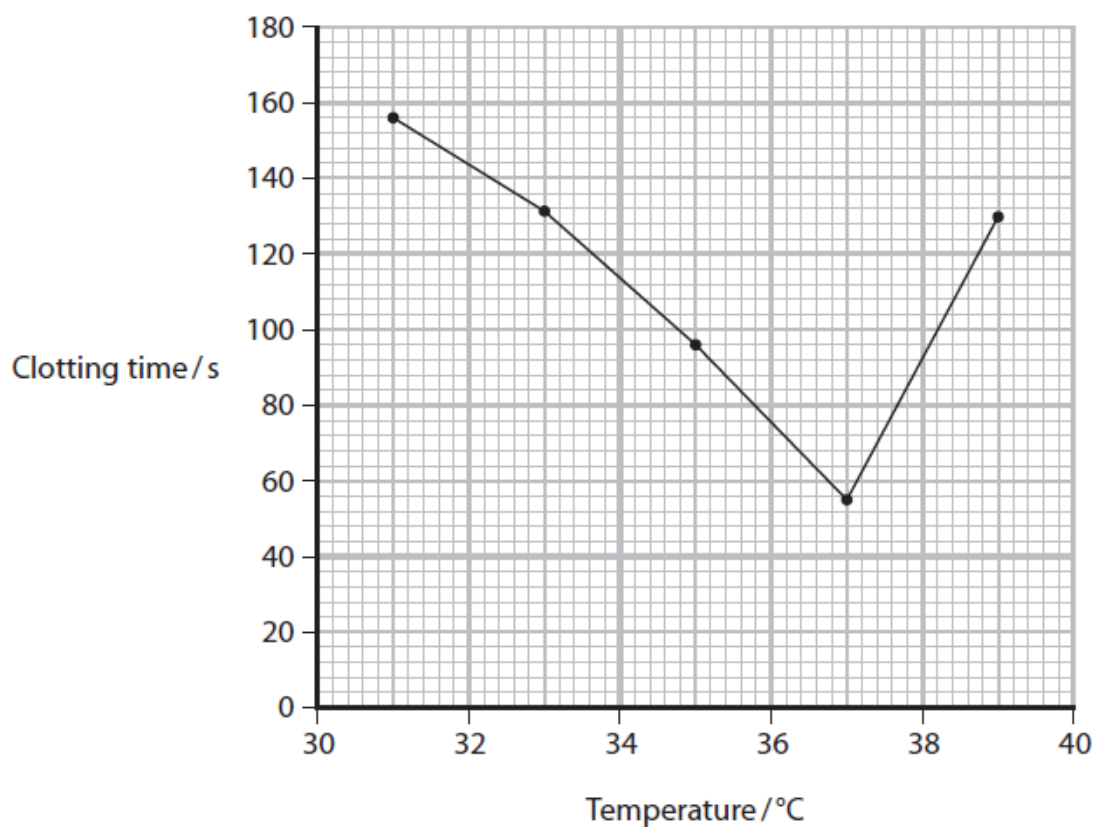
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(Total for question = 2 marks)

Q17.

A scientist investigated the effect of temperature on the time it takes for blood to clot.

The graph shows the results of this investigation.



Explain how these results show that enzymes are involved in blood clotting.

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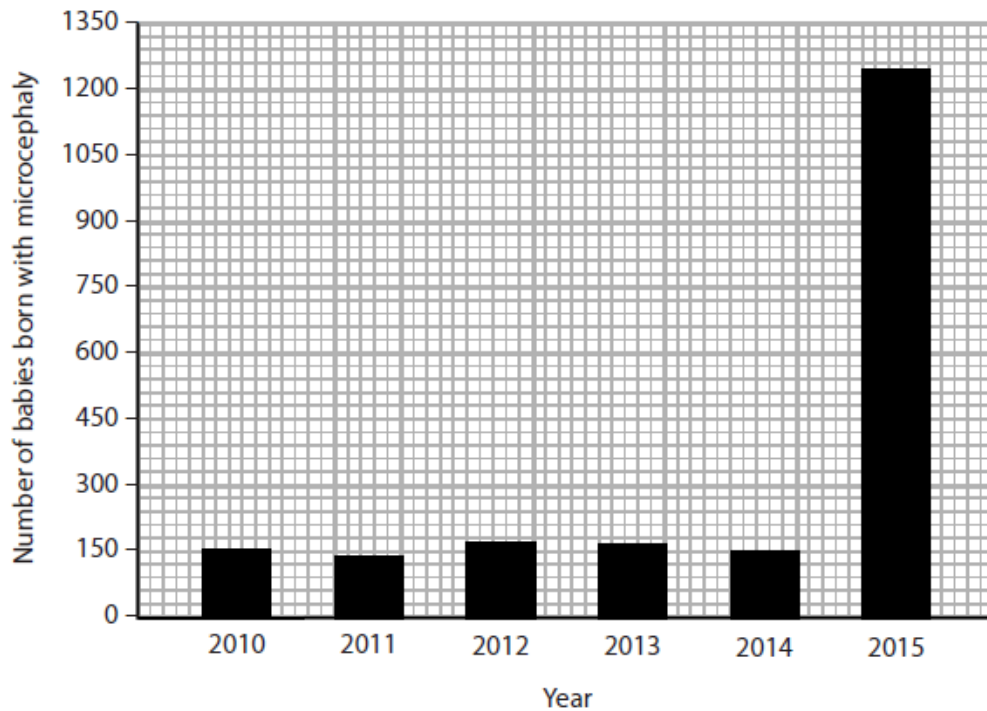
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(Total for question = 3 marks)

In February 2016, the World Health Organisation (WHO) declared a public health emergency because of the spread of the Zika virus.

The mild symptoms, such as joint pains, headaches and a slight temperature increase lasted only a few days. However, Zika virus has been linked to a birth defect called microcephaly.

The graph shows the number of babies born with microcephaly in Brazil from 2010 to 2015.



During the replication of the Zika virus, the ten proteins that are coded for in the RNA are produced as a single polyprotein molecule.

Explain how this polyprotein molecule is converted into ten separate protein molecules.

(2)

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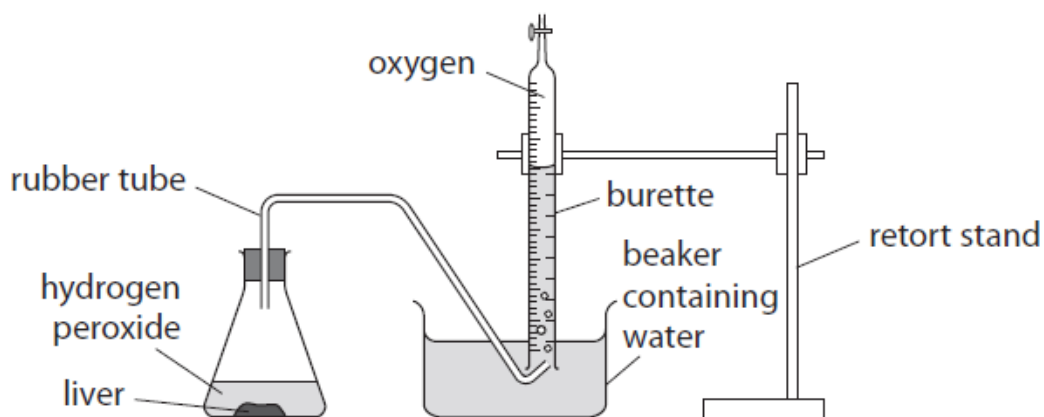
(Total for question = 2 marks)

Q19.

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

Explain why it was important to measure the volume of oxygen in the first 10 seconds.

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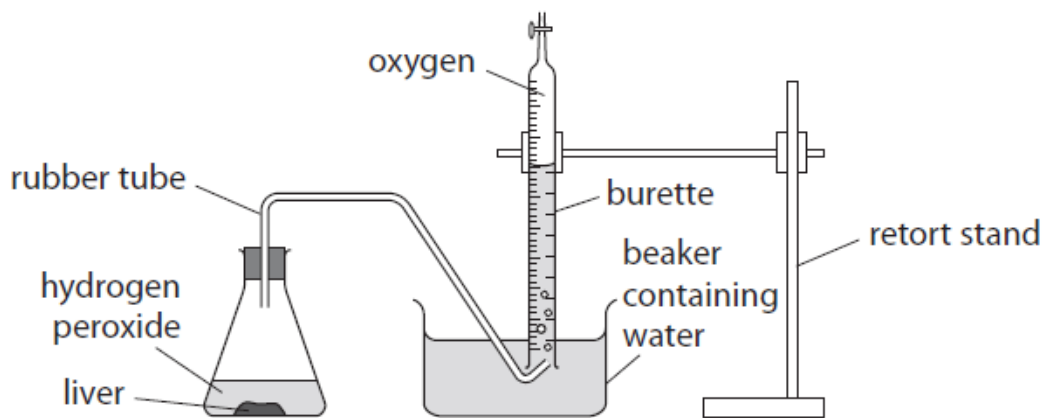
(Total for question = 2 marks)

Q20.

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

Explain why no oxygen was produced when boiled liver was added to the hydrogen peroxide.

(3)

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(Total for question = 3 marks)

Mark Scheme

Q1.

Question Number	Answer	Additional Guidance	Mark
	An explanation that contains three of the following: • higher kinetic energy so more enzyme-substrate complexes formed (1) • at very high temperatures the rate decreases due to denaturation (1) • because of bond changes in the enzyme altering the active site (1) • so substrate no longer fits active site (and rate of product formation decreases)	Accept higher kinetic energy increases rate of collisions (between enzyme and substrate) Accept at temperatures above the optimum the rate decreases due to denaturation Accept changes to tertiary structure change the shape of the active site Accept bonds break in the enzyme altering the active site Do not accept peptide bonds Accept substrate no longer complementary to active site	Exp (3)

Q2.

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)

Q3.

Question Number	Answer	Additional Guidance	Mark
	An explanation including three of the following - As more potato is added more oxygen is produced because more enzyme is present (1) - increase in volume of oxygen expected as surface area increases (1) {volume of oxygen produced / graph / rate of reaction} may level off as substrate {is not in excess / is used up} (1)	Accept rate of reaction would increase because there is more enzyme available Accept increased rate of reaction expected as surface area increases Accept at a higher number of cubes, concentration of hydrogen peroxide may be a limiting factor	Exp (3)

Q4.

Question Number	Answer	Additional Guidance	Mark
(i)	An explanation that makes reference to the following: - citrate binds to another site on the enzyme, activating the enzyme (1) - so that the structure of the enzyme is changed (1) - so that active site binds more effectively to the substrate (1) - an increase in fatty acyl CoA molecules inhibits the substrate binding to the active site (1) - due to competitive inhibition (1)	Accept citrate and fatty acyl CoA molecules act together to regulate the activity of the enzyme	(5)
(ii)	An explanation that makes reference to two of the following: - fewer fatty acids will be made (1) - so that less fat is stored (1) - because the enzyme is being inhibited despite being activated by citrate (1)	Allow (less fat stored so) fat reserves used	(2)

Q5.

Question Number	Answer	Additional Guidance	Mark
	An explanation that makes reference to four of the following: - because 30 °C is an appropriate temperature for one species and provides enough oxygen for the other species (1) - because if the temperature was above {30 / 40} °C there would be less oxygen dissolved in it (1) - so there would not be enough oxygen for {respiration / metabolism / ATP production} (1) - because if the temperature was above {25 / 30} °C the enzymes would be denaturing (1) - because the temperature was below {25 / 30} °C the enzymes would not have enough {kinetic energy / collisions / enzyme substrate complexes} (1)	Accept because 30 °C satisfies the requirements of both fish Do not accept start to denature Accept for 1 mark 30 °C is close to the optimum temperature for the enzymes	(4)

Q6.

Question Number	Answer	Additional Guidance	Mark
(i)	A description that makes reference to four of the following: - sample taken from the female genital tract (1) - bacteria grown on {selective / indicator} media (1) - bacteria grown on media containing different types of antibiotics (1) - use of {antibodies / DNA profiling} (1) - using {Gram staining / cell shape / colony shape / colony colour} (1)		(4)

Question Number	Answer	Additional Guidance	Mark
(ii)	An explanation that makes reference to three of the following: - because they grow on the skin cells preventing pathogenic bacteria from doing so (1) - because they use the glycogen so less {glucose / energy / glycogen} available for the pathogenic bacteria (1) - because they produce lactic acid which inhibits the growth of pathogenic bacteria (1) - because the low pH denatures the enzymes of the pathogenic bacteria (1)	ACCEPT below optimum pH	(3)

Q7.

Question Number	Answer	Additional Guidance	Mark
(i)	A calculation that makes reference to the following: - correct tangent to the curve (1) - correct measurement of the y axis and x axis distances (1) - correct calculation of gradient (1)	Accept a straight line that must through or between 19.0 mg cm⁻³ or 24.0 mg cm⁻³ at 30 s. TE for mark points 2 and 3 from wrong tangent TE for mark point 3 for correct gradient calculation with no tangent ($y \div x$) <u>Example of calculation:</u> $21.0 / 30 = 0.70 \text{ mg cm}^{-3} \text{ s}^{-1}$ (accept range of between 0.63 mg cm³ s⁻¹ to 0.80 mg cm³ s⁻¹) Correct answer with no working gains full marks	(3)

Question Number	Answer	Additional Guidance	Mark
(ii)	A explanation that makes reference to two of the following: • active site (of enzyme) {shape / structure} changes (1) • because {H⁺ ions / acid} {affects ionic bonds / affects hydrogen bonds} (of enzyme) (1) • so {substrate/ monophenol} no longer fits / binds (1)	Accept {shape / structure} of monophenol changes so it no longer fits active site Accept because H⁺ ions / bind to monophenol Accept E/S complexes do not form	(2)

Question Number	Answer	Additional Guidance	Mark
(iii)	An explanation that makes reference to two the following: • tropolone is similar in {shape / structure} to monophenol (1) • tropolone acts as a competitive inhibitor / binds in the active site (1) • so it prevents {binding of monophenol / enzyme substrate complexes forming} decreasing the {rate of reaction / production of quinone / enzyme activity}(1)		(2)

Q8.

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 cm³ / 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)

Question Number	Acceptable Answer	Additional Guidance	Mark
(i)	non-competitive (inhibition)		(1)

Question Number	Acceptable Answer	Additional Guidance	Mark
(ii)	An answer that makes reference to the following: • appropriate assembly of reaction mixture: copper ions added to cellulose and cellulase (1) • use of control with cellulose, cellulase and no copper ions (1) • details of steps taken to control two relevant variables (1) • use of colorimeter to obtain quantitative measure of the dependent variable (1) • calculation of mean results from repeat data (1)	Allow other controls e.g. With copper ions, cellulose and no cellulase / With copper ions, cellulase and no cellulose Allow filtering, drying and weighing the precipitate	(5)

Q10.

Question Number	Answer	Mark
(i)	The only correct answer is A hydrogen only <i>B is incorrect because ionic bonds are not involved in the secondary structure</i> <i>C is incorrect because disulfide bonds are not involved in the secondary structure</i> <i>D is incorrect because ionic bonds are not involved in the secondary structure</i>	1

Question Number	Answer	Additional Guidance	Mark
(ii)	An explanation that makes reference to three of the following: • {tyrosinase active / melanin made} in cooler regions (1) • tyrosinase denatures / {hydrogen / ionic} bonds break (in warm / light regions) (1) • active site changes shape / tertiary structure changes (1) • no enzyme substrate complexes form / tyrosine does not bind (to tyrosinase / enzyme) (1)	ACCEPT converse throughout ACCEPT enzyme for tyrosinase for all mark points ACCEPT optimum temperature is cool / low	3

Q11.

Question Number	Acceptable Answer	Additional Guidance	Mark
	An explanation that makes reference to the following: • (a mutation results in) a different sequence of amino acids (1) • therefore different R groups / side chains (1) • resulting in changes to { ionic / hydrogen bonding / disulphide bridges } (1) • change in shape of active site causing a change in enzyme activity (1)		(4)

Q12.

Question Number	Answer	Additional Guidance	Mark
	An explanation that makes reference to four of the following: - as temperature increases up to 10°C hatching increases and then decreases (1) - enzyme activity affects {hatching / development / growth} (1) (below 10°C) increase in temperature increases {kinetic energy / enzyme-substrate complexes / successful collisions between enzyme} (1) (above 10°C) temperature too high denatures enzymes (1) - higher temperature results in less dissolved oxygen available (1)	Piece together ACCEPT converse DO NOT ACCEPT starts to denature ACCEPT shape of active site changed	(4)

Q13.

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 CO₂ 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.

Q14.

Question Number	Answer	Additional guidance	Mark
(i)	An explanation that makes reference to five of the following: • (cyanide) changes tertiary structure / changes active site / substrate no longer fits {active site / enzyme} (1) • therefore transport of {electrons / hydrogen ions} stops (1) • carrier(s) cannot be reduced (1) • (so that) ATP manufacture stops / less ATP made (1) • muscles {cannot contract / go into spasm} / breathing stops / heart stops (1) • any other named biological process that requires ATP stops eg active transport (1)		(5)

Question Number	Answer	Additional guidance	Mark
(ii)	• mass of cyanide that kills = 10 mg (1) • mass of cyanide inhaled per minute • time taken to inhale lethal dose (1) OR • mass of cyanide that kills = 10 mg (1) • volume that provides lethal dose (1) • time taken to inhale lethal dose (1)	$1 \times 10 = 10 \text{ mg}$ $0.24 \text{ mg dm}^{-3} \times 15 = 3.6 \text{ (mg per minute)}$ $10 \div 3.6 = \mathbf{2.78} \text{ minutes (3sf)}$ $1 \times 10 = 10 \text{ mg}$ $10 \div 0.24 = 41.67 \text{ (dm}^3\text{)}$ $41.67 \div 15 = \mathbf{2.78} \text{ minutes (3sf)}$	(3)

Q15.

Question Number	Answer	Additional Guidance	Mark
(i)	An answer that makes reference to the following: One from: (increase in) rates are same up to 30 to 32 (mg dm^{-3}) / at 13 ($\mu\text{g s}^{-1}$) (1) - both reduce rate up to 30 to 32 (mg dm^{-3}) / at 13 ($\mu\text{g s}^{-1}$) (1) Then: - B stops increasing but A continues to increase (1)		(2)

Question Number	Answer	Additional Guidance	Mark
(ii)	An explanation that makes reference to the following - inhibitor B because reaction does not reach rate without inhibitor (1) - because it binds to {enzyme / allosteric site} (1) - changes {active site} (1)	ACCEPT levels off / plateaus / stays the same / does not maximum rate DO NOT ACCEPT binds to active site	(3)

Q16.

Question Number	Answer	Additional Guidance	Mark
	An explanation that makes reference to two of the following: - an inhibitor of the bacterial enzyme may not affect the human one (1) - description of effect of treatment eg fatty acids not made so {less respiration / bacteria die} (1) - so that there will be fewer side effects if used as a treatment for infections (1)	Allow enzymes are specific Allow is an effective antibiotic	(2)

Q17.

Question Number	Answer	Additional Guidance	Mark
	An explanation that makes reference to the following: - clotting takes longer at low temperature due to {low kinetic energy / fewer enzyme-substrate collisions} (1) - clotting time is least at {body/optimum} temperature (1) (clotting takes longer) at {temperatures above 37°C / high temperatures} (because) enzymes are denatured (1)	Accept clotting takes less time as temperature increases because {kinetic energy increases / more enzyme-substrate collisions}	(3)

Q18.

Question Number	Answer	Additional Guidance	Mark
	An explanation that makes reference to the following: • {hydrolysis / breaking} of peptide bonds (1) • by protease (1)		(2)

Q19.

Question Number	Answer	Mark
	An explanation that makes reference to the following: • it is the initial rate of reaction (1) • substrate / hydrogen peroxide is in excess / not limiting / substrate / hydrogen peroxide decreases / becomes limiting (1)	(2)

Q20.

Question Number	Answer	Mark
	An explanation that makes reference to three of the following: • catalase / enzyme {denatured / change to tertiary structure} (1) • because {hydrogen / ionic / disulfide} bonds are broken (1) • {shape} of active site changed (1) • therefore no longer {binds / fits / attaches} to {substrate / hydrogen peroxide} / no enzyme substrate complexes (1)	(3)

