PEARSON EDEXCEL A-LEVEL BIOLOGY B · 9BI0

# BIOLOGY



## EXAM QUESTION PACK

TOPIC 1: BIOLOGICAL MOLECULES

ENZYMES

| SCORE | PERCENTAGE |
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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)**

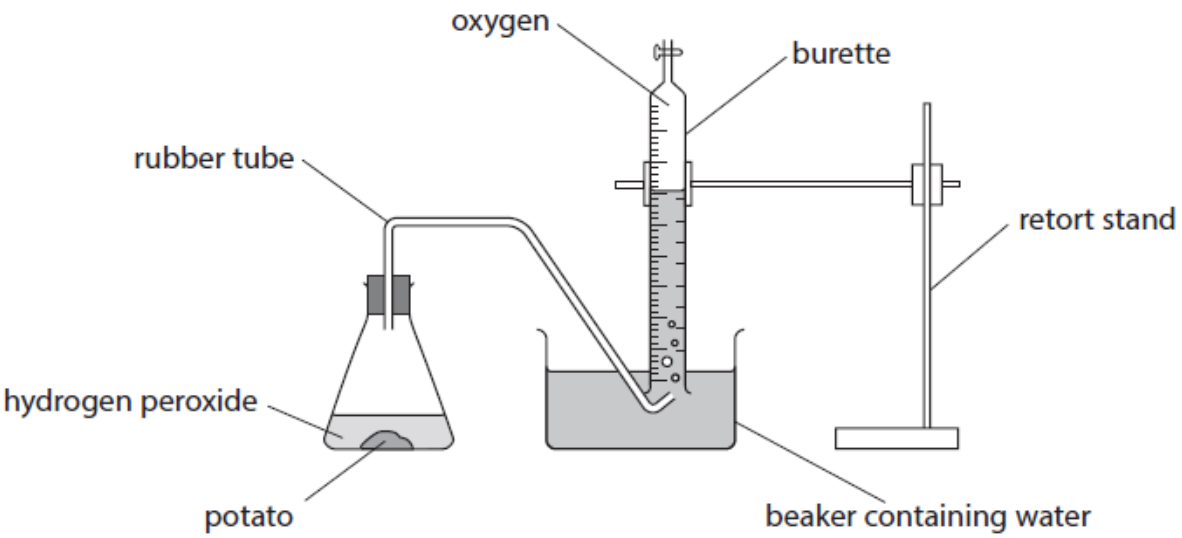
Q2.

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.

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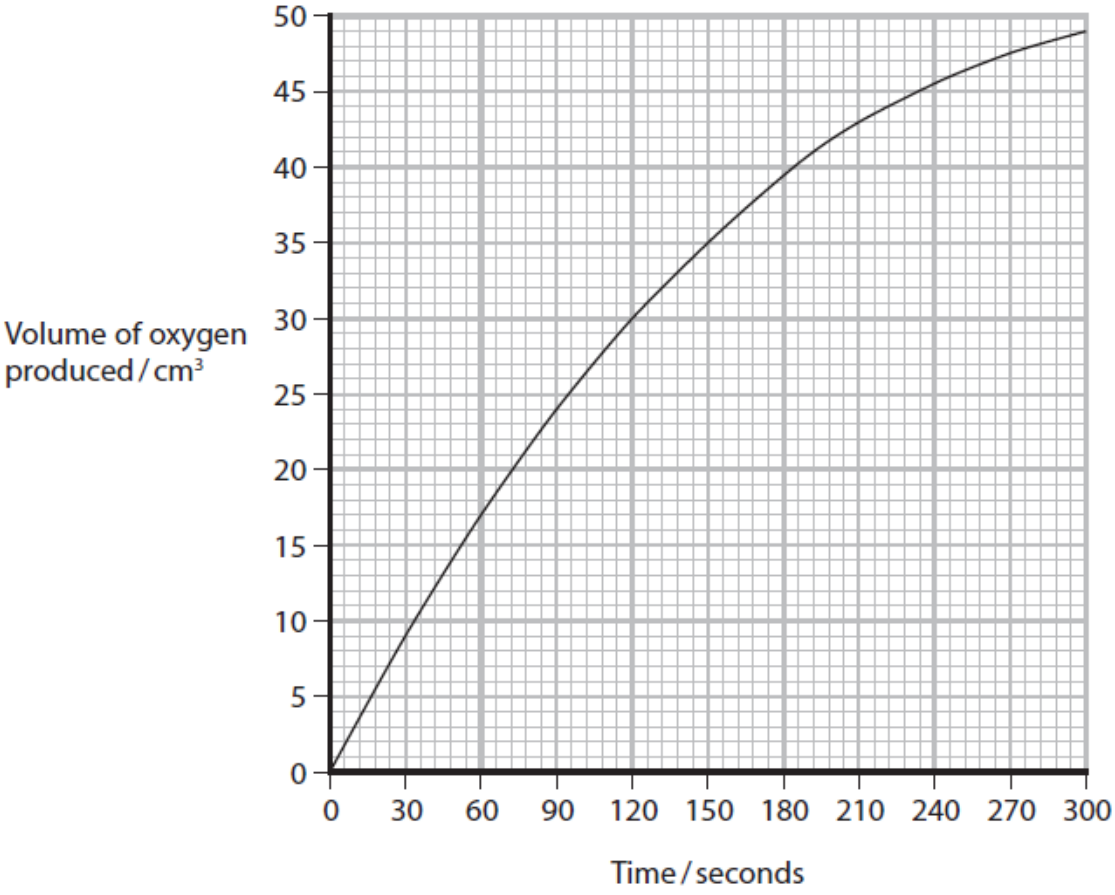
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(ii) The graph shows the results of the investigation.




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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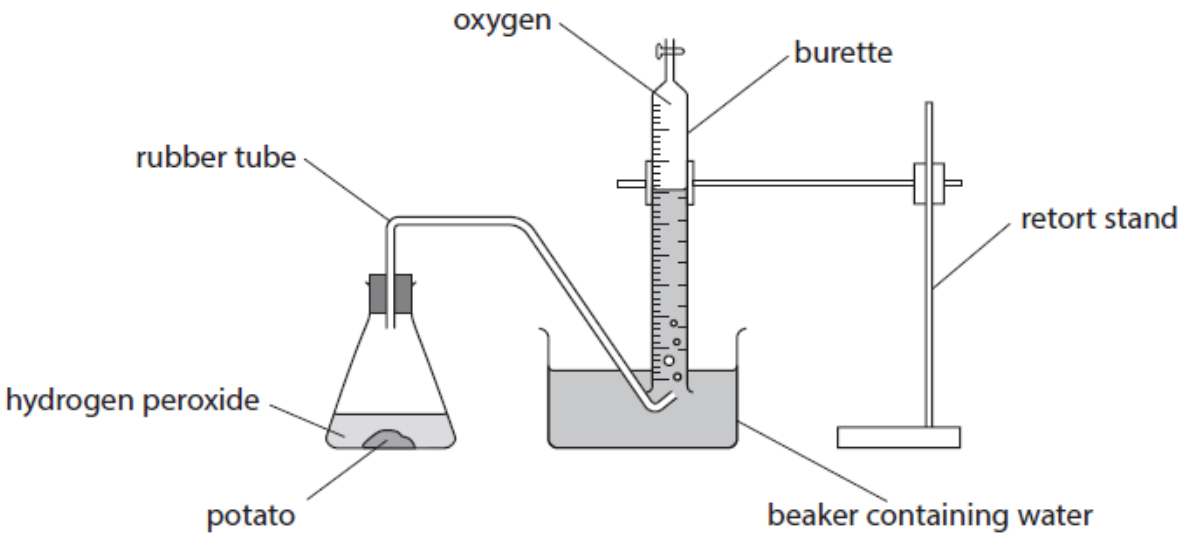
Q3.

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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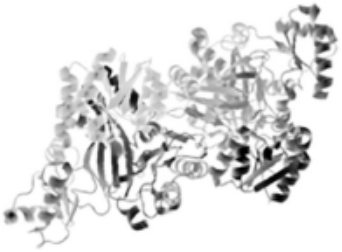
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**(Total for question = 3 marks)**

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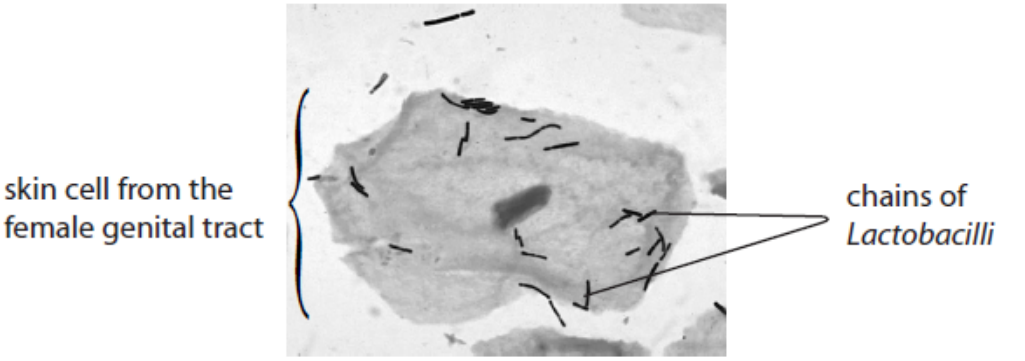
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(ii) The photograph shows *Lactobacilli* on a skin cell from the female genital tract.




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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**(Total for question = 7 marks)**

Q7.

Polyphenol oxidase is an enzyme found in many plant cells.

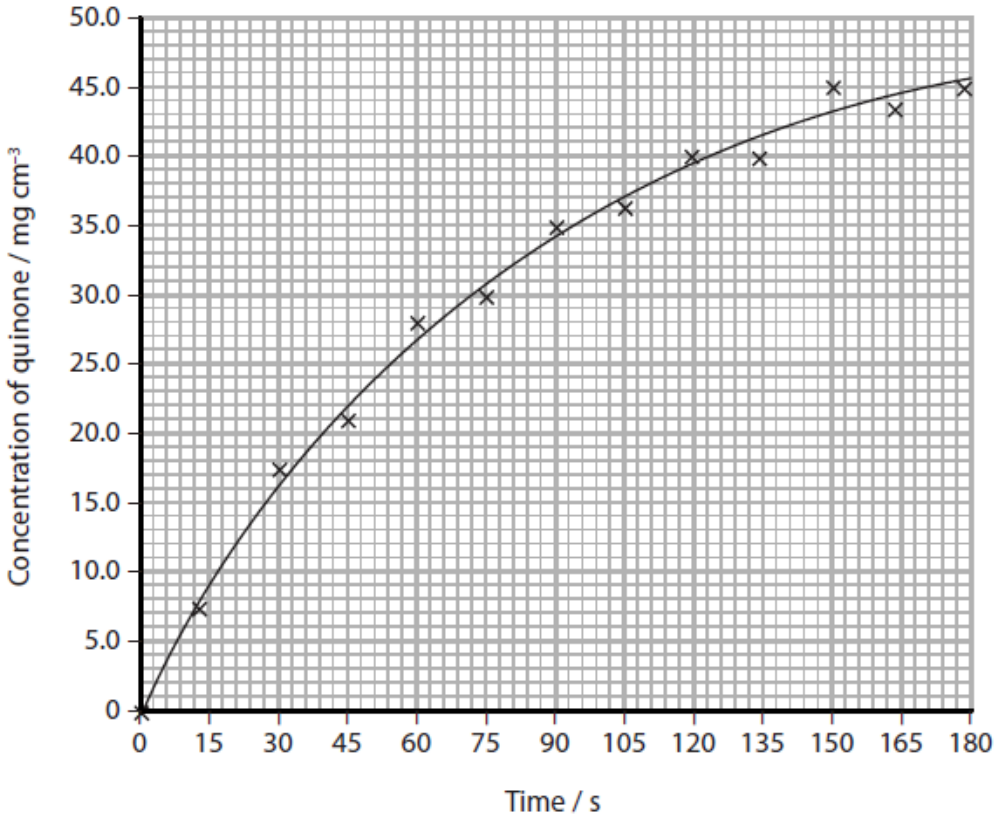
This enzyme catalyses the following reaction

monophenol (colourless) + oxygen ⟶ quinone (brown)

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.

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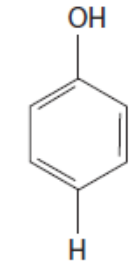
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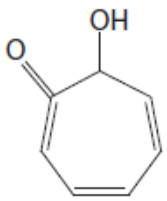
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(iii) The diagram shows the structures of monophenol and a molecule called tropolone.

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




monophenol




tropolone

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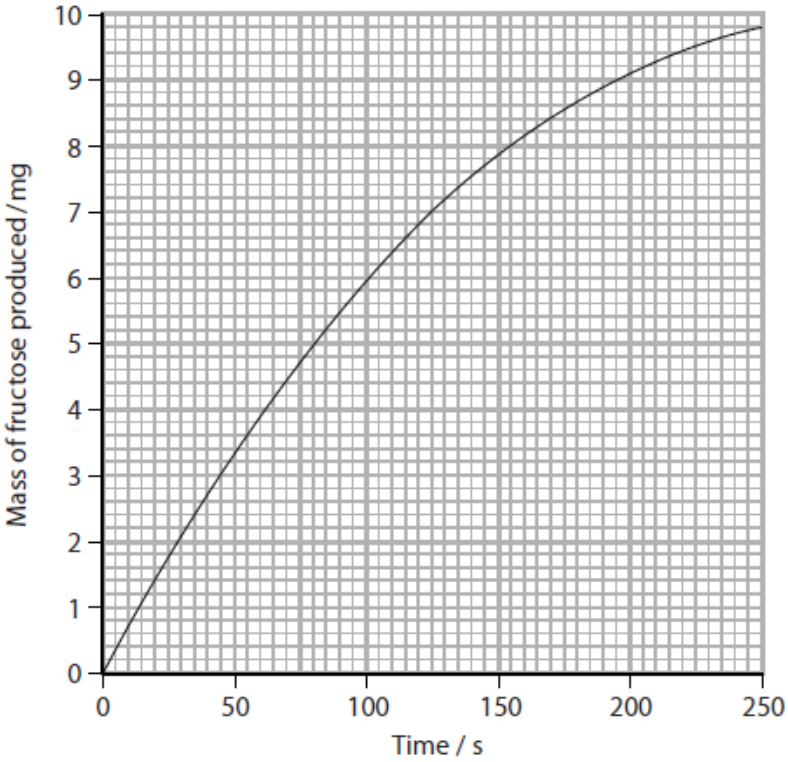
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(ii) A student investigated the activity of glucose isomerase.

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.

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

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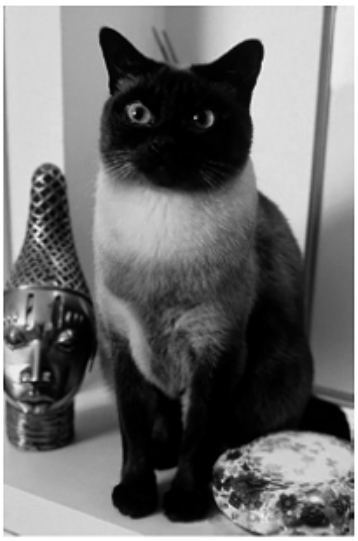
Q10.

**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.

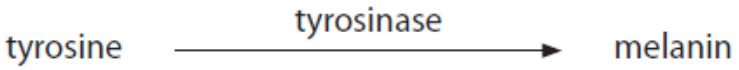


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The pigment melanin causes the fur to turn black.
This pigment is produced by tyrosinase, an enzyme coded by the TYR gene.




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.

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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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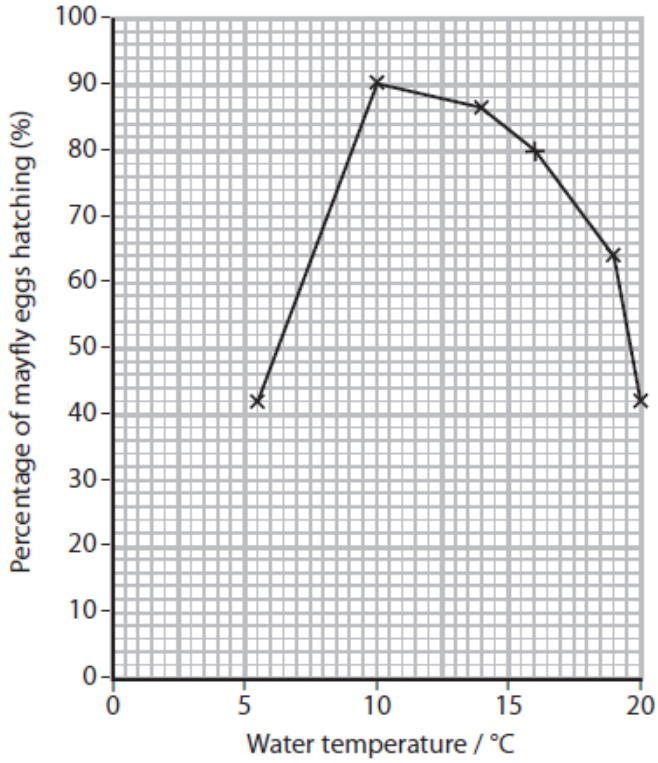
Q12.

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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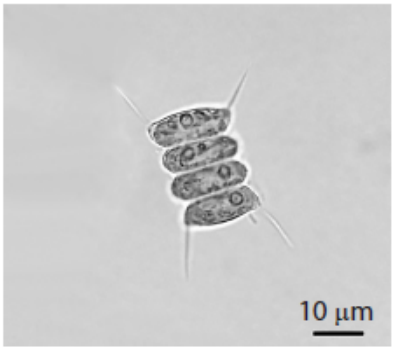
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**(Total for question = 4 marks)**

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.

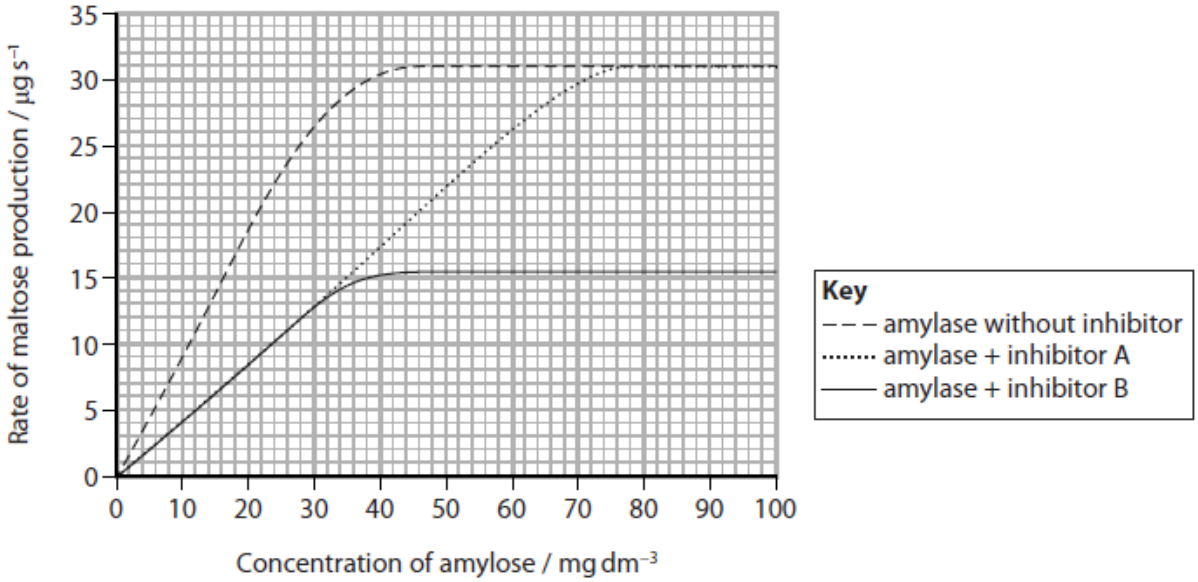
Some plants produce amylase inhibitors.

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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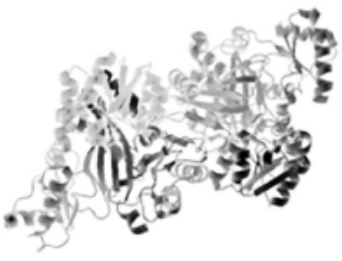
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**(Total for question = 5 marks)**

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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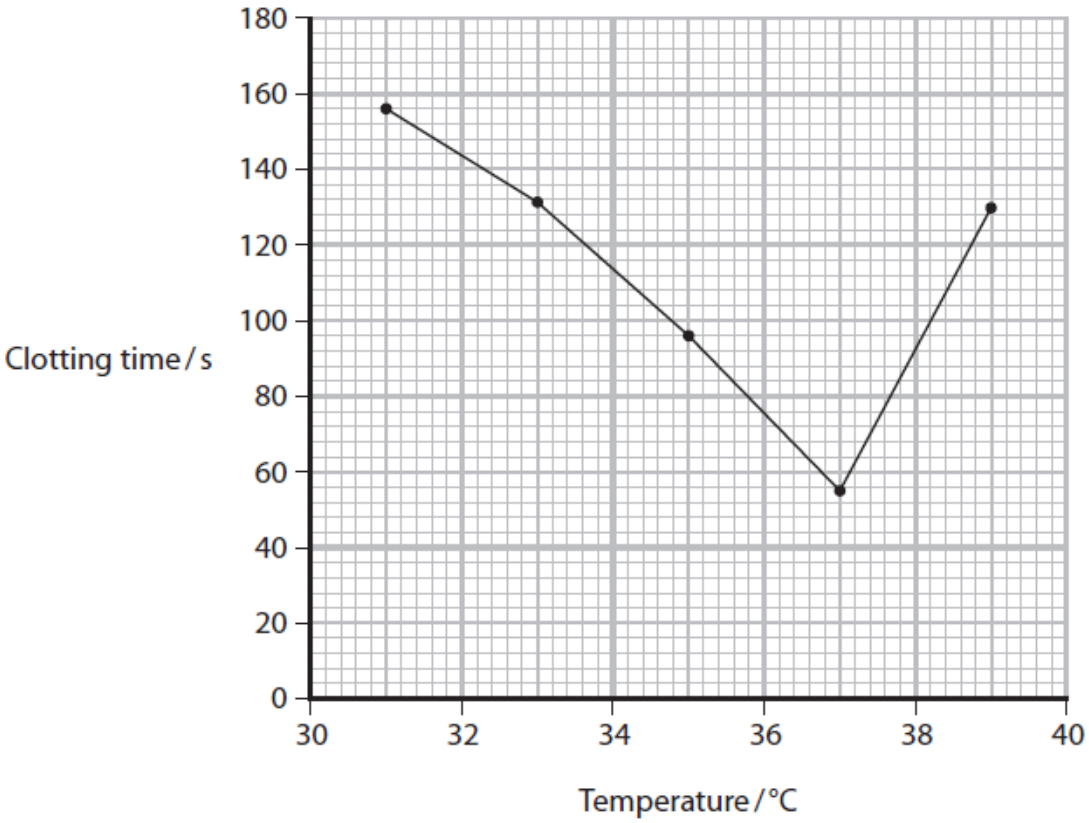
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**(Total for question = 2 marks)**

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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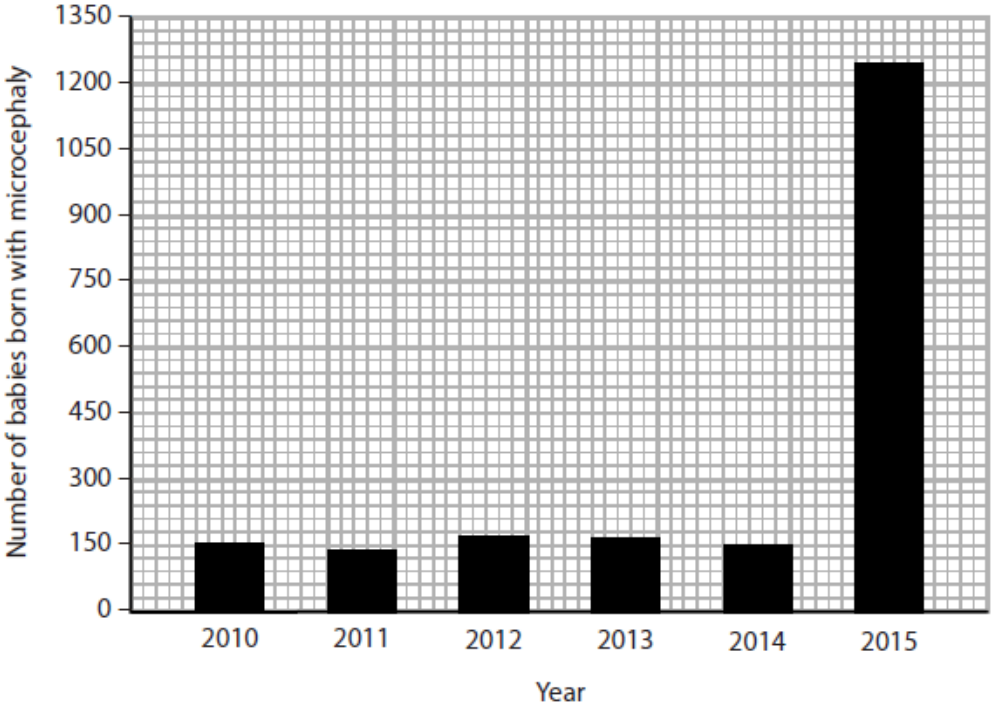
**(Total for question = 3 marks)**

Q18.

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.

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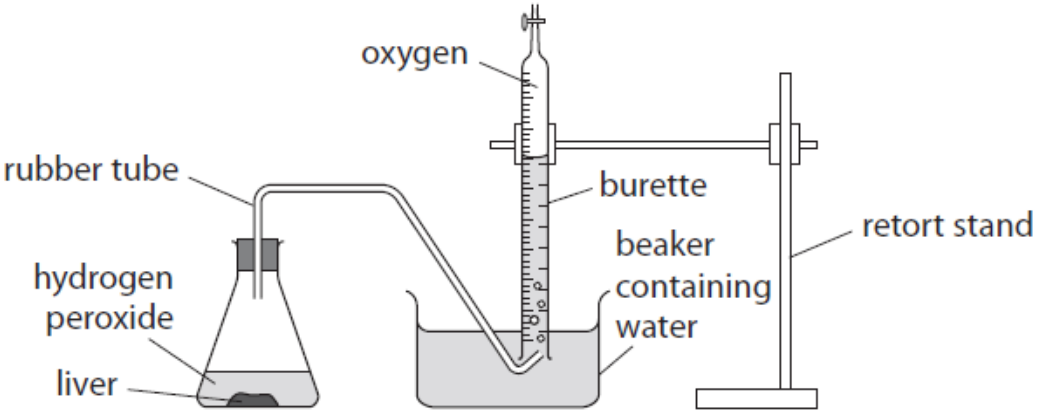
**(Total for question = 2 marks)**

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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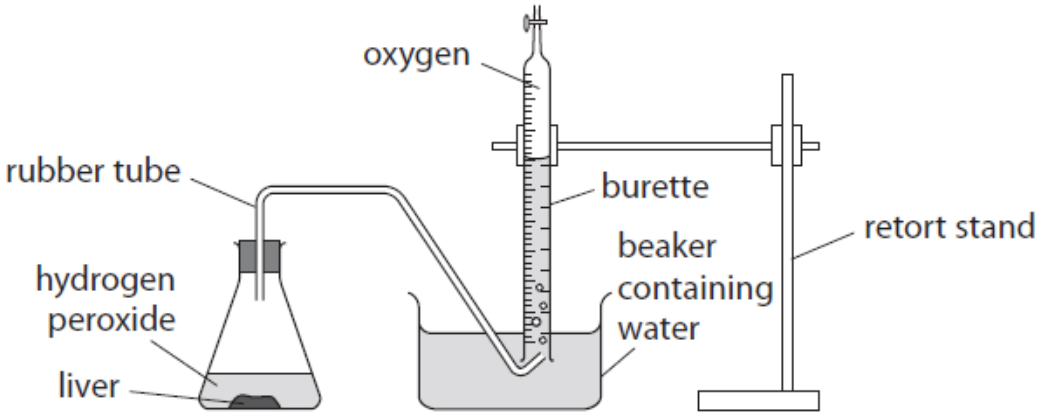
**(Total for question = 2 marks)**

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.

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**(Total for question = 3 marks)**