AQA

General Certificate of Education
Advanced Subsidiary Examination
June 2012

Biology

BIO3T/Q12/test

Unit 3T  AS Investigative Skills Assignment

Written Test

For submission by 15 May 2012

For this paper you must have:
• the task sheet, your results and your calculations
• a ruler with millimetre measurements
• a calculator.

Instructions
• Use black ink or black ball-point pen.
• Fill in the boxes at the top of this page.
• Answer all questions.
• You must answer the questions in the space provided. Do not write outside the box around each page or on blank pages.
• Do all rough work in this book. Cross through any work you do not want to be marked.

Time allowed
• 1 hour 15 minutes

Information
• The marks for questions are shown in brackets.
• The maximum mark for this paper is 34.
• You will be marked on your ability to:
  – use good English
  – organise information clearly
  – use scientific terminology accurately.

Details of additional assistance (if any). Did the candidate receive any help or information in the production of this work? If you answer yes give the details below or on a separate page.

Yes [ ] No [ ]

Teacher Declaration:
I confirm that the candidate’s work was conducted under the conditions laid out by the specification. I have authenticated the candidate’s work and am satisfied that to the best of my knowledge the work produced is solely that of the candidate.

Signature of teacher .......................................................... Date .....................................

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**Section A**

These questions are about your investigation of the effect of substrate concentration on the rate of an enzyme-controlled reaction.

Use your Task Sheet and your results table and graph to answer them.

*Answer all questions in the spaces provided.*

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<table>
<thead>
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<tbody>
<tr>
<td><strong>1</strong></td>
<td>You were told to remove the card from the catalase extract and shake off any surplus liquid (step 3). Explain why it is necessary to shake off surplus liquid.</td>
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|   | *(2 marks)* |
| **2** | It would have been better if you had kept temperature and pH constant in this investigation. |
| **2 (a)** | Describe how you could keep temperature constant. |
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|   | *(2 marks)* |
| **2 (b)** | Describe how you could keep pH constant. |
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|   | *(1 mark)* |
3 You were told to repeat the measurements at each concentration of hydrogen peroxide (step 7).

How many repeats did you carry out at a concentration of 100% hydrogen peroxide? Explain why you carried out this number of repeats.

Number of repeats ...........................................................................................................

Explanation ....................................................................................................................
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(1 mark)

4 In this investigation, you found the time taken for the card to rise to the surface. Explain why this is a valid measure of the rate of the reaction.

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(3 marks)
5 Another student carried out the same investigation as you did. She obtained the results shown in the graph.

![Graph showing the rate at which a card rose to the surface as a function of hydrogen peroxide concentration.]

5 (a) Describe the results that the student obtained.

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(2 marks)

5 (b) What factor limited the rate of reaction between hydrogen peroxide concentrations of 0% and 30%? Give the evidence for your answer.

Factor ...................................................................................................................................

Evidence ..................................................................................................................................
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(2 marks)
A student carried out a similar investigation to yours. He decided to carry out repeats using the same piece of card in the same tube. Each time the card reached the surface, he immediately pushed it back down again. He noticed that the card took longer to return to the surface each time. Explain why the card took longer to return to the surface.

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(2 marks)
Catalase is used in a number of industrial processes. It is normally obtained from a fungus called *Aspergillus niger*. Scientists produced a mutant strain of *A. niger* called K30. They wanted to know if this mutant strain produced more catalase than the normal strain of *A. niger*.

- The scientists grew samples of the normal strain of the fungus and of the K30 strain on jelly in separate Petri dishes. The jelly contained a blue substance which is turned colourless by catalase.
- They incubated the dishes for 3 days then measured the diameter of the colourless zone around the fungus.
- They calculated the ratio of the diameter of the colourless zone to the diameter of the fungus.

The diagram shows the dishes after incubation.
Resource B

Some of the catalase produced by *Aspergillus niger* is intracellular and some is extracellular. Intracellular enzymes stay inside the cells that produce them. Extracellular enzymes are secreted from the cells that produce them.

Another group of scientists grew a different strain of *A. niger*.

- *A. niger* grows from tiny structures called spores. The scientists kept the spores in an isotonic medium at a low temperature until they needed them.

- They put spores of *A. niger* into a 500 cm³ flask containing a sterile medium. The medium contained starch.

- They measured the total amount of catalase and the amount of extracellular catalase produced by the fungus over a period of 100 hours.

The graph shows their results.
Section B

Use the information in the Resource Sheet and your own knowledge to answer the questions.

Answer all questions in the spaces provided.

Use Resource A to answer Questions 7 to 9.

7 The scientists grew both strains of fungi on dishes kept at 30 °C. Keeping the dishes at a temperature of 15 °C would affect the results. Use your knowledge of kinetic energy to explain why.

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(2 marks)

8 (a) The scientists gave their results as ratios. Explain the advantage of giving the results of this investigation as a ratio.

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(2 marks)

8 (b) For the normal strain the ratio of the diameter of the colourless zone to the diameter of the fungus was 1.1 : 1.

Calculate the ratio of the diameter of the colourless zone to the diameter of the fungus for the K30 strain. Show your working.

Ratio = ...................................................

(2 marks)
The catalase produced by the K30 strain of the fungus is mainly an extracellular enzyme. This means that the fungus secretes catalase from its cells into the jelly in the Petri dish.

Describe and explain the evidence from the investigation which shows that the catalase is an extracellular enzyme.

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(2 marks)

Use Resource B to answer Questions 10 to 14.

10 (a) The scientists kept the spores in an isotonic medium until they were needed. Suggest why it was important that the medium was isotonic.

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(2 marks)

10 (b) The scientists kept the spores at a low temperature until they were needed. Suggest why.

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(1 mark)
11 Starch is a source of carbon, hydrogen and oxygen for the fungus. Name one other chemical element that must be in the culture medium before A. niger can synthesise catalase. Give the reason for your answer.

Chemical element ............................................................................................................
Reason ............................................................................................................................
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(2 marks)

12 To get reliable results in this investigation, the medium must be sterile. Explain why.
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(2 marks)

13 (a) At what time was the concentration of intracellular catalase highest?
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(1 mark)

13 (b) Between what times was the rate of total catalase production highest?
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(1 mark)
14 Technologists prefer to manufacture extracellular enzymes rather than intracellular enzymes. This is because intracellular enzymes are more expensive to purify than extracellular enzymes. Suggest why intracellular enzymes are more expensive to purify.

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(2 marks)

END OF QUESTIONS