22096011

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BIOLOGY
STANDARD LEVEL
PAPER 2

Wednesday 6 May 2009 (afternoon)

1 hour 15 minutes

Candidate session number

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INSTRUCTIONS TO CANDIDATES

- Write your session number in the boxes above.
- Do not open this examination paper until instructed to do so.
- Section A: answer all of Section A in the spaces provided.
- Section B: answer one question from Section B. Write your answers on answer sheets. Write your session number on each answer sheet, and attach them to this examination paper and your cover sheet using the tag provided.
- At the end of the examination, indicate the numbers of the questions answered in the candidate box on your cover sheet and indicate the number of sheets used in the appropriate box on your cover sheet.

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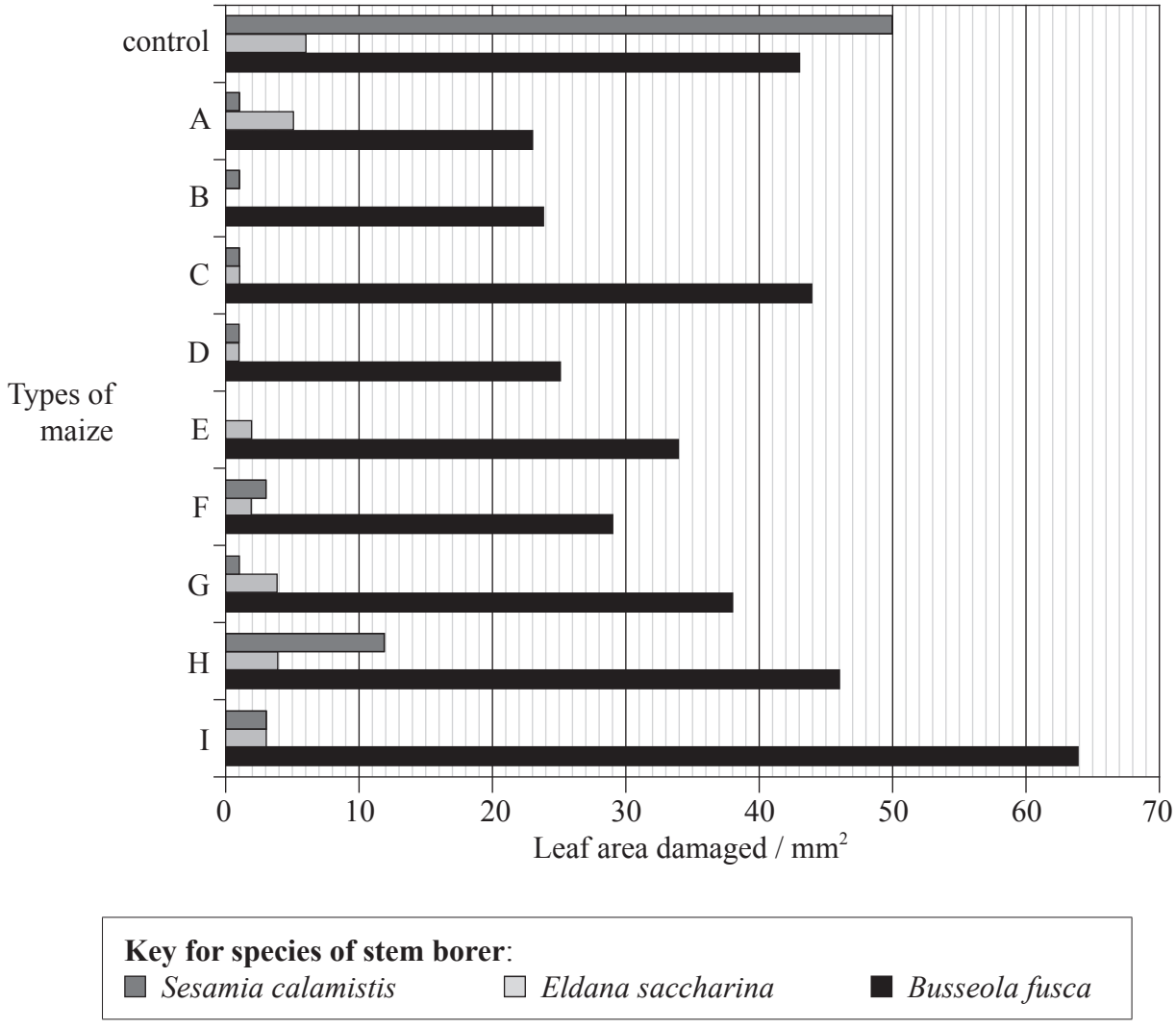
SECTION A

*Answer **all** the questions in the spaces provided.*

1. Genetic engineering allows genes for resistance to pest organisms to be inserted into various crop plants. Bacteria such as *Bacillus thuringiensis* (Bt) produce proteins that are highly toxic to specific pests.

Stem borers are insects that cause damage to maize crops. In Kenya, a study was carried out to see which types of Bt genes and their protein products would be most efficient against three species of stem borer. The stem borers were allowed to feed on nine types of maize (A–I), modified with Bt genes. The graph below shows the leaf areas damaged by the stem borers after feeding on maize leaves for five days.



[Source: adapted from S Mugo, *et al*., (2005), *African Journal of Biotechnology*, **4**(13), pages 1490–1504]

(This question continues on the following page)

(Question 1 continued)

(a) (i) State what would be used as the control in this experiment. *[1]*

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(ii) Calculate the percentage difference in leaf area damaged by *Sesamia calamistis* between the control and maize type H. Show your working. *[2]*

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(b) Outline the effects of the three species of stem borer on Bt maize type A. *[2]*

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(c) Evaluate the efficiency of the types of Bt maize studied, in controlling the three species of stem borers. *[2]*

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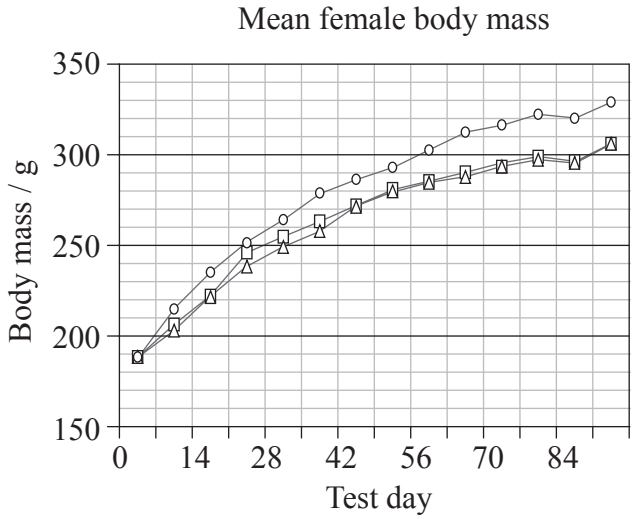
(This question continues on the following page)

(Question 1 continued)

Before the use of genetically modified maize as a food source, risk assessment must be carried out. A 90-day study was carried out in which 3 groups of 12 adult female rats were fed either:

- seeds from a Bt maize variety
- seeds from the original non-Bt maize variety
- commercially prepared rat food.

All the diets had similar nutritional qualities.



[Source: adapted from L A Malley, *et al*., (2007), *Food and Chemical Toxicology*, **45**, pages 1277–1292]

(d) Calculate the change in mean mass of female rats fed on Bt maize from day 14 to 42. *[1]*

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(e) Describe the change in mean mass for the female rats during the 90-day experiment. *[2]*

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(f) Evaluate the use of Bt maize as a food source compared to the other diets tested. *[3]*

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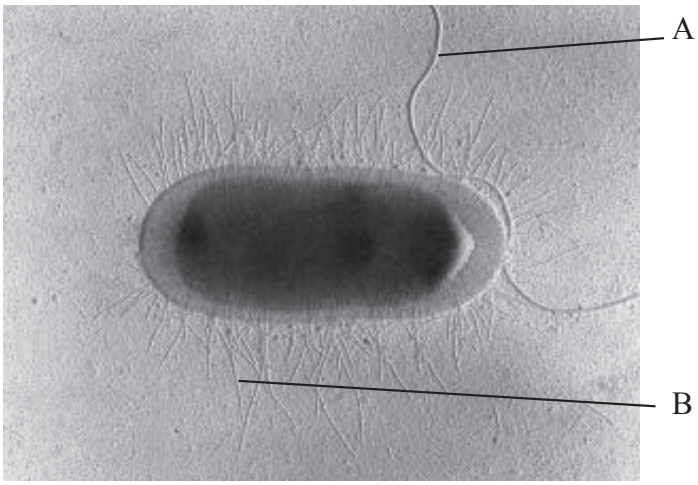
2. The electron micrograph below shows an *E. coli* cell.



[Source: www.microbiology.umaryland.edu/images/bact_em.jpg]

(a) Identify the structures labelled A and B in the electron micrograph above and state **one** function of each. *[2]*

A: Name . . . . . .

Function . . . . . .

B: Name: . . . . . .

Function: . . . . . .

(b) Compare prokaryotic and eukaryotic cells. *[3]*

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3. (a) Define *active site*. *[1]*

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(b) Explain enzyme-substrate specificity. *[3]*

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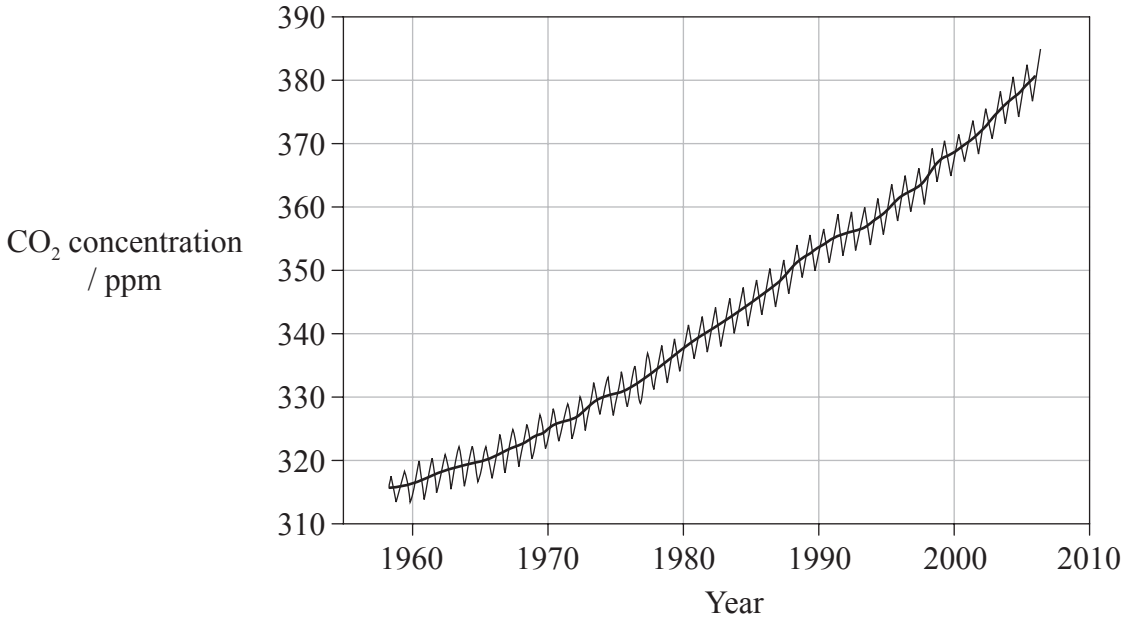
4. Below is a graph of atmospheric CO_2 levels measured at Mauna Loa Observatory, Hawai'i.



[Source: adapted from Dr P Tans, NOAA Earth System Research Laboratory]

(a) Explain the observed changes in atmospheric CO_2 concentration from 1960 to 2005. *[3]*

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(b) Outline the precautionary principle. *[2]*

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5. Distinguish between type I and type II diabetes. *[3]*

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SECTION B

*Answer **one** question. Up to two additional marks are available for the construction of your answer. Write your answers on the answer sheets provided. Write your session number on each answer sheet, and attach them to this examination paper and your cover sheet using the tag provided.*

6. (a) Draw a labelled diagram to show the structure of a membrane. *[5]*

(b) Outline how vesicles are used to transport materials secreted by a cell. *[6]*

(c) Explain how the structure of a villus in the small intestine is related to its function. *[7]*

7. (a) Draw a labelled diagram to show how **two** nucleotides are joined together in a single strand of DNA. *[3]*

(b) Outline a basic technique for gene transfer. *[6]*

(c) Explain the process of translation. *[9]*

8. (a) Draw a labelled diagram of the adult male reproductive system. *[5]*

(b) Describe the role of sex chromosomes in the control of gender and inheritance of hemophilia. *[7]*

(c) Discuss the ethical issues associated with IVF. *[6]*