



**BIOLOGY**  
**STANDARD LEVEL**  
**PAPER 3**

Tuesday 15 May 2007 (morning)

1 hour

Candidate session number

0	0							
---	---	--	--	--	--	--	--	--

**INSTRUCTIONS TO CANDIDATES**

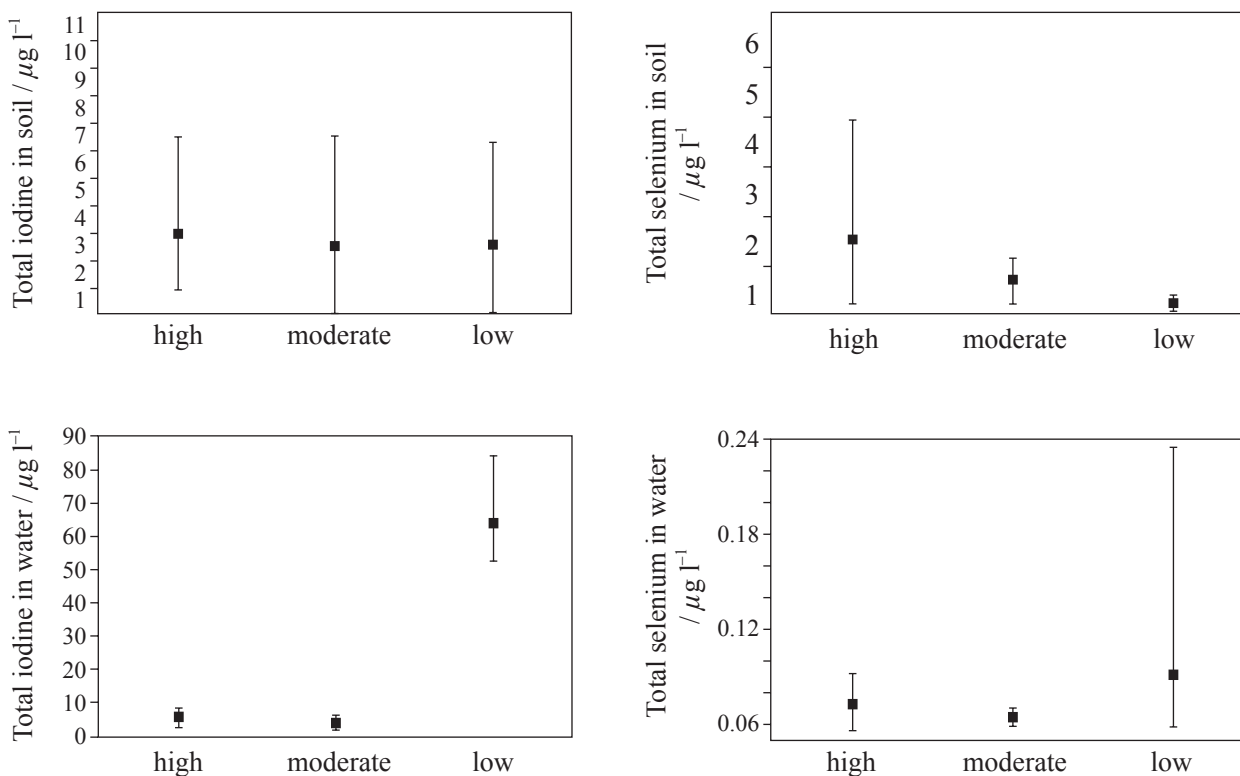
- Write your session number in the boxes above.
- Do not open this examination paper until instructed to do so.
- Answer all of the questions from two of the Options in the spaces provided. You may continue your answers on answer sheets. Write your session number on each answer sheet, and attach them to this examination paper and your cover sheet using the tag provided.
- At the end of the examination, indicate the letters of the Options answered in the candidate box on your cover sheet and indicate the number of answer sheets used in the appropriate box on your cover sheet.



**Option A — Diet and Human Nutrition**

**A1.** Goitre is a condition found in many parts of the world and was thought to be due to a shortage of iodine in the diet. In recent years, it has been suggested that a deficiency in the mineral selenium (Se) may be an important factor in the onset of goitre and other iodine deficiency disorders.

A study was carried out in Sri Lanka to investigate whether goitre incidence was related to iodine and selenium levels in soil and water. Villages in the study were classified as low, moderate or high incidence of goitre. The results are shown in the graphs below. The range of iodine and selenium concentrations are shown by the vertical lines in the graphs. The mean concentrations are represented by squares (■).



[Source: adapted from M Fordyce *et al.* (2000), *The Science of the Total Environment*, **263**, pages 127–141, ©Elsevier 2000]

(a) (i) Outline the function of minerals in the diet. [1]

.....

.....

(ii) State **one** function of iodine in the body. [1]

.....

.....

*(This question continues on the following page)*



*(Question A1 continued)*

- (b) Compare the influence of soil levels of selenium and iodine on the incidence of goitre. [2]

.....  
.....  
.....  
.....

- (c) Using the data, evaluate the proposal to reduce goitre incidence by supplementing the diet with selenium and iodine. [3]

.....  
.....  
.....  
.....  
.....  
.....  
.....



**A2.** (a) State **two** sources of disaccharides in the diet. [1]

- 1. ....
- 2. ....

(b) Outline the use of absorbed carbohydrates. [3]

.....  
.....  
.....  
.....  
.....  
.....  
.....

(c) Discuss the relationship between high levels of saturated lipids in the diet and health of the individual. [4]

.....  
.....  
.....  
.....  
.....  
.....  
.....  
.....  
.....  
.....



**A3.** (a) State **two** reasons why chemical additives are used in the preparation of foods. [1]

1. ....

2. ....

(b) Outline the possible harmful effect of the use of **one** named food additive. [2]

Additive: .....

Harmful effect: .....

.....

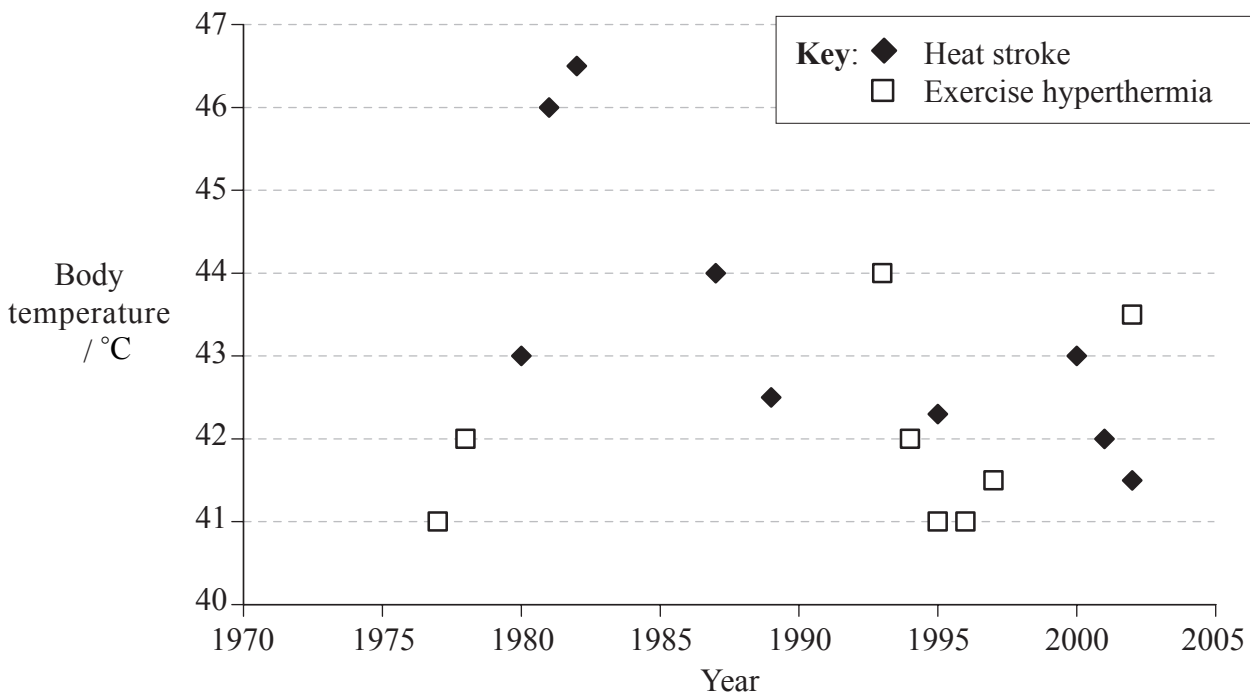
.....



**Option B — Physiology of Exercise**

**B1.** In warm humid weather, marathon runners are at risk of hyperthermia. Sometimes during races, their body temperatures exceed 41°C. At this level of hyperthermia, fatigue and other physiological problems are common. For example, heat stroke occurs when the body becomes dehydrated. This condition reduces blood volume making it difficult for the body to lose heat through vasodilation and sweating.

The graph below shows the relationship between the maximum temperatures recorded in individual patients suffering hyperthermia and heat stroke. All of the patients in this study subsequently recovered without any long-term health effect.



[Source: adapted from M Kosaka, *et al.*, (2004), *Journal of Thermal Biology*, 29, pages 495–501, ©Elsevier 2004]

(a) (i) Identify the year in which the maximum temperature achieved by a surviving patient was recorded. [1]

.....

(ii) Compare the temperatures of those suffering heat stroke with those suffering exercise hyperthermia. [1]

.....

.....

(This question continues on the following page)



*(Question B1 continued)*

- (b) It has been claimed that publication of research on hyperthermia has lead to a reduction in the number of cases of hyperthermia in athletes. Evaluate this claim using the data provided in the graph opposite. [2]

.....  
.....  
.....  
.....

- (c) Suggest how athletes can avoid hyperthermia. [2]

.....  
.....  
.....  
.....  
.....



**B2.** The interaction of the various parts of a joint result in it having a wide range of movement.

(a) Draw a labelled diagram of a human elbow joint. [4]

(b) (i) State the type of muscle which controls movement at the human elbow joint. [1]

.....

(ii) State **two** structural features of this type of muscle tissue. [1]

.....  
.....





**B3.** (a) Outline the role of myoglobin in muscles. [2]

.....  
.....  
.....  
.....

(b) Explain how adrenalin affects muscle activity. [4]

.....  
.....  
.....  
.....  
.....  
.....  
.....  
.....  
.....  
.....

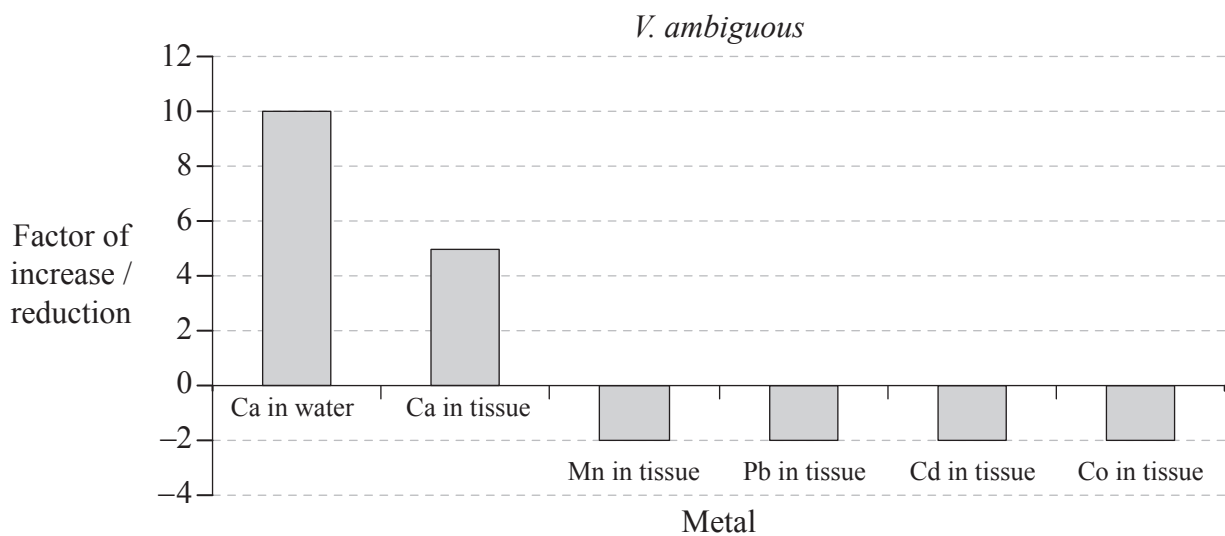
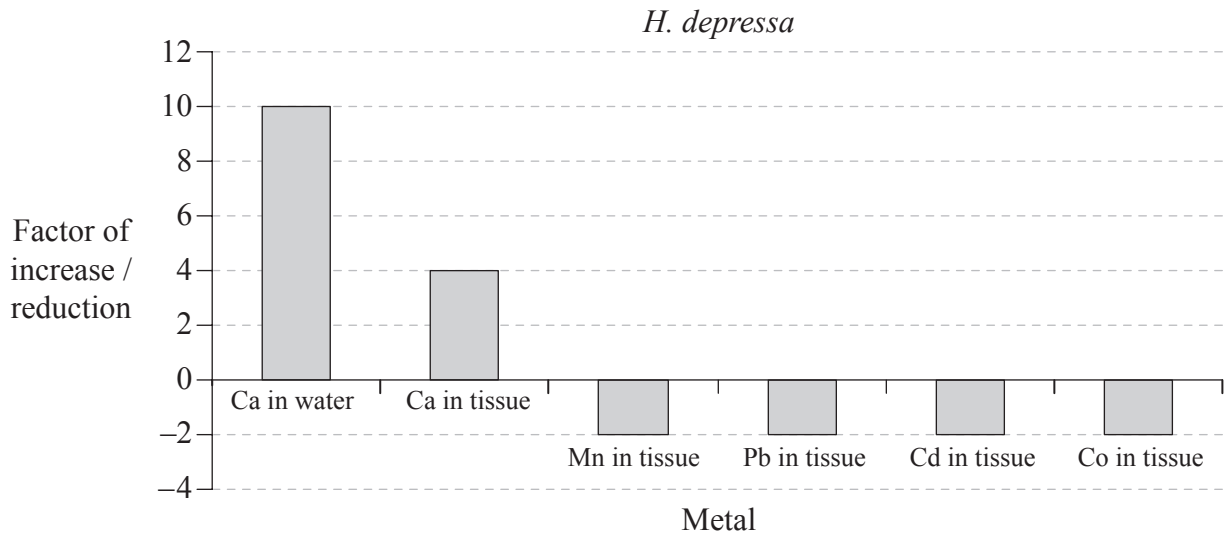


**Option C — Cells and Energy**

**C1.** Scientists have long been concerned about the effect of heavy metals in foods that we eat. Aquatic filter feeders including bivalves, such as mussels and oysters, are especially prone to accumulation of heavy metals.

Calcium is taken into bivalves through protein channels, but other non-essential elements may also be taken in.

To investigate the relationship between the uptake of calcium and other elements, the bivalves *Hyridella depressa* and *Velesunio ambiguous* were placed in solutions containing ten times the normal level of calcium (Ca). The elements manganese (Mn), lead (Pb), cadmium (Cd) and cobalt (Co) were also present in the solutions at normal concentrations. The results are shown below.



[Source: adapted from S J Markish and R A Jeffree (1994), *Aquatic Toxicology*, 29, pages 257–290, ©Elsevier 1994]

(This question continues on the following page)



*(Question C1 continued)*

- (a) (i) Outline the effect of increasing calcium levels in the water on calcium levels in the tissue of the bivalves. [1]

.....  
.....

- (ii) Outline the effect of increasing calcium levels in the water on metals other than calcium in the tissue of the bivalves. [1]

.....  
.....

- (b) Suggest reasons for the effects of calcium on the levels of the other metals in the tissues. [2]

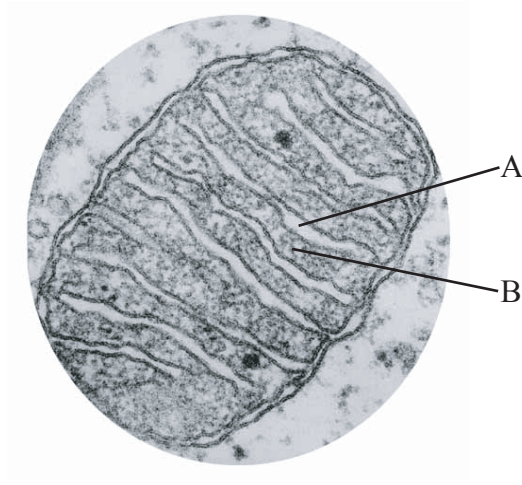
.....  
.....  
.....  
.....

- (c) Evaluate the implications of these results for monitoring water quality in regions where bivalves are harvested. [3]

.....  
.....  
.....  
.....  
.....  
.....



**C2.** The mitochondrion carries out key reactions in the cells of eukaryotes.



[Source: D S Friend, Brigham and Women’s Hospital, [www.nigms.nih.gov/news/science\\_ed/mito1.html](http://www.nigms.nih.gov/news/science_ed/mito1.html)]

(a) (i) State the name of label A and label B in the photomicrograph above. [1]

A: .....

B: .....

(ii) State the processes that occur at label A and label B. [1]

A: .....

B: .....

(b) Explain the relationship between the structure of the mitochondrion and its function. [3]

.....  
.....  
.....  
.....  
.....  
.....  
.....  
.....

**C3.** (a) Draw and label the structure of a chloroplast as seen in electron micrographs. [3]

(b) Explain the relationship between the absorption spectrum and the action spectrum of photosynthetic pigments. [3]

.....

.....

.....

.....

.....

.....

.....

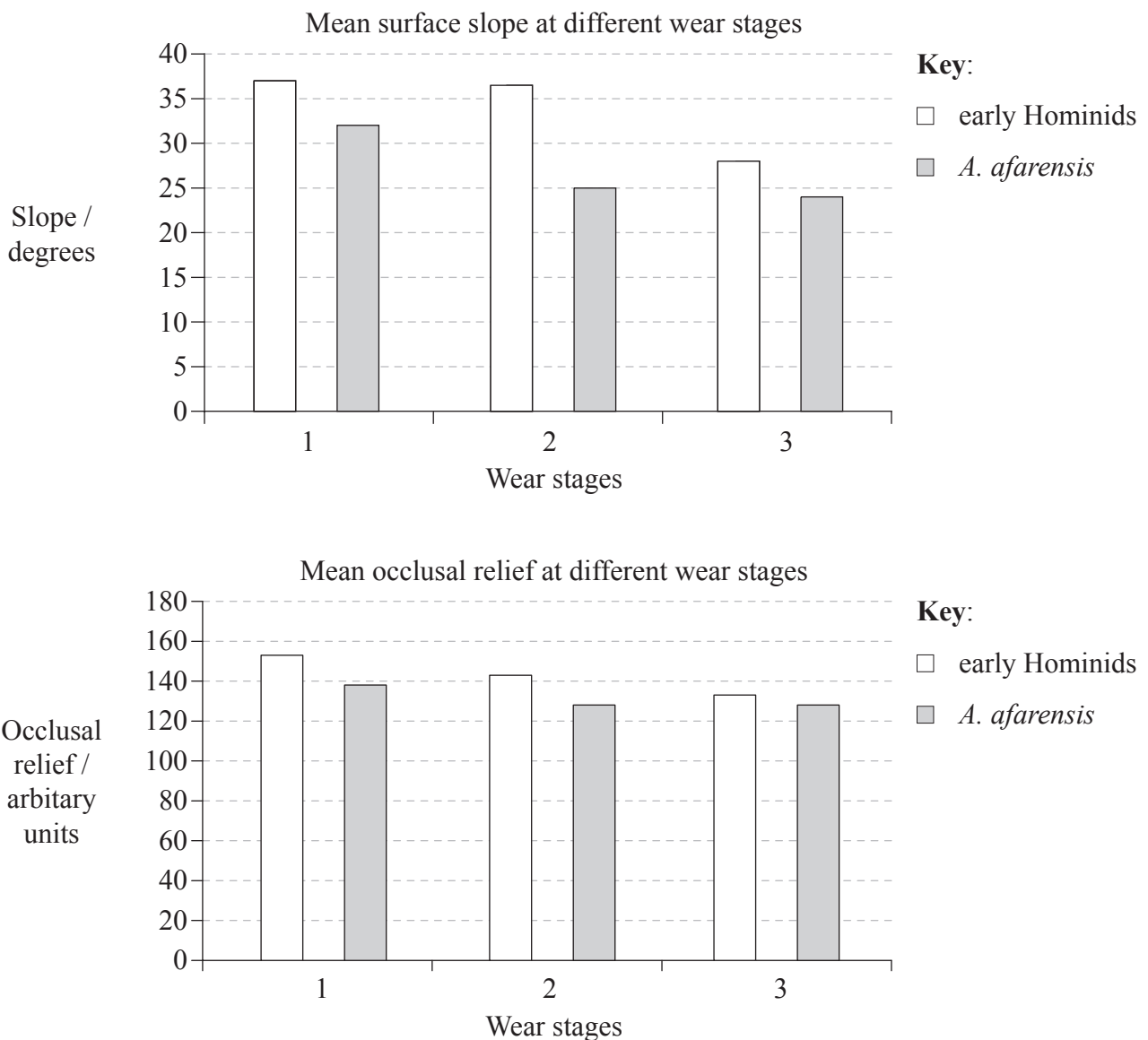


**Option D — Evolution**

**D1.** New technologies such as dental topographic analysis are being used to help understand how early Hominids lived. This technique allows the pattern of wear of teeth over a lifetime to be analysed, revealing what types of food were eaten.

Teeth from early Hominids and *Australopithecus afarensis* were compared. The upper surfaces of the teeth were analysed for slope and occlusal relief (how closely the upper and lower teeth fit when brought together). The teeth examined were in groups of similar stages of wear to ensure consistency of results.

The lower the slope and occlusal relief, the flatter the teeth. Flat teeth are best suited to crushing hard, brittle foods. More shaped teeth are better suited to eating elastic foods such as meat.



[Source: P Ungar, (2004), *Journal of Human Evolution*, 46, pages 605–622, ©Elsevier 2004]

*(This question continues on the following page)*



(Question D1 continued)

- (a) (i) State what changes occurred to all teeth with wear. [1]

.....  
.....

- (ii) Compare the teeth of early Hominids with those of *A. afarensis*. [2]

.....  
.....  
.....  
.....

- (b) Using the data, suggest how the diets of early Hominids and *A. afarensis* differed. [2]

.....  
.....  
.....  
.....

- (c) Suggest what other evidence would help scientists to determine what food was eaten by early Hominids. [2]

.....  
.....  
.....  
.....  
.....



**D2.** (a) (i) Define the term *half-life*. [1]

.....  
.....

(ii) State **two** radio-isotopes used for determining the age of fossils. [1]

.....  
.....

(b) Explain how biochemical variations can be used as an evolutionary clock. [3]

.....  
.....  
.....  
.....  
.....  
.....

**D3.** (a) Outline the experiments of Miller and Urey into the origin of organic compounds. [3]

.....  
.....  
.....  
.....  
.....  
.....

(b) Discuss a possible origin of membranes and prokaryotic cells. [3]

.....  
.....  
.....  
.....  
.....  
.....  
.....  
.....





Blank page

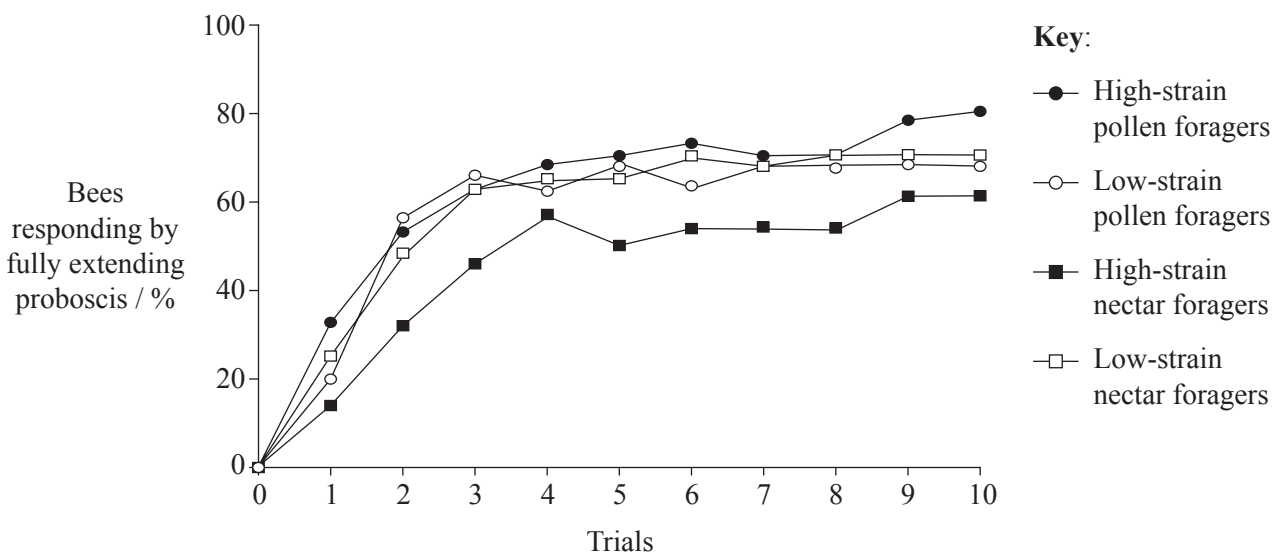


**Option E — Neurobiology and Behaviour**

**E1.** Sucrose responsiveness and tactile learning were investigated in two strains of honeybees called “high” and “low”. Bees of the high strain preferentially collect pollen whereas low strain bees mainly forage for nectar, a source of sucrose.

When sucrose solution is presented to a bee’s antennae, the bee extends its proboscis (feeding tube) to varying degrees – the so-called proboscis extension response (PER).

Each bee was presented with a small grooved plate, which was the conditioned stimulus. In ten trials, pollen and nectar foragers of the two strains scanned the plates with their antennae for three seconds. The PER was elicited by touching the antennae with a droplet of sucrose solution. The number of bees that extended their proboscis **fully** was counted. The bees were then allowed to feed from the sucrose solution for about one second. The time interval between each trial was five minutes. The results of this experiment are shown below.



[Source: adapted from R Scheiner, et al. (2001), *Neurobiology of Learning and Memory*, 76, pages 138–150, ©Elsevier 2001]

(a) (i) Determine which of the four groups of bees was **least** responsive to sucrose. [1]

.....

.....

(ii) Compare the pattern of response in the different bee strains. [2]

.....

.....

.....

.....

(This question continues on the following page)



*(Question E1 continued)*

(b) Suggest, giving a reason, what type of learning is shown in this study. [2]

.....  
.....  
.....  
.....

(c) Explain how this process illustrates natural selection. [3]

.....  
.....  
.....  
.....  
.....  
.....  
.....



**E2.** (a) Define the term *innate behaviour*. [1]

.....  
.....

(b) Outline the pain withdrawal reflex as an example of innate behaviour. [1]

.....  
.....

(c) (i) Draw and label a diagram of the structure of the spinal cord and the spinal nerves to show the components of a reflex arc. [3]

(ii) On the diagram you have drawn above indicate with an arrow the direction of the reflex as it travels through the spinal cord. [1]



**E3.** (a) State **two** examples of social behaviour in animals. [1]

1. ....

2. ....

(b) Discuss the role of altruistic behaviour in a **named** animal society. [3]

.....  
.....  
.....  
.....  
.....  
.....  
.....



**Option F — Applied Plant and Animal Science**

**F1.** The market for organic products is constantly increasing. Organic milk production has gained importance throughout the world. There is a large body of research comparing organic and conventional livestock farming systems, but local and specific factors are often not taken into account.

A study was carried out to compare organic and conventional farming in France.

Comparison of technical characteristics of conventional versus organic dairy farms in France (Holstein cows)

Mean Values	Conventional	Organic
Milk quota / 1000 l yr <sup>-1</sup>	254	190
Number of dairy cows ha <sup>-1</sup>	32	35
Land area per farm / ha	35	37
Milk output / 1 ha <sup>-1</sup> yr <sup>-1</sup>	7260	5130
Days on pasture yr <sup>-1</sup>	82	141
Feeding cost to produce 1 litre of milk / €*	0.20	0.19
Soil nitrogen balance / kg excess ha <sup>-1</sup> yr <sup>-1</sup>	105	55

\* € = Euro, the currency used in France

[Source: adapted from A Rosati and A Aumaitre (2004), *Livestock Production Science*, **90**, pages 41–51, ©Elsevier 2004]

(a) (i) Identify the type of farming that resulted in the greatest milk productivity. [1]

.....

(ii) Calculate the percentage difference in milk output between conventional and organic dairy farms. [1]

.....  
.....

*(This question continues on the following page)*



(Question F1 continued)

- (b) Deduce, giving a reason, which type of milk production is more efficient. [2]

.....

.....

.....

.....

- (c) Compare the biological issues surrounding organic versus conventional farming. [3]

.....

.....

.....

.....

.....

.....

.....

- F2.** (a) (i) Define the term *interspecific hybridization*. [1]

.....

.....

- (ii) Outline **one** example of interspecific hybridization. [2]

.....

.....

.....

- (b) Explain how plant-breeding programmes have led to an improvement in the yield of a **named** cereal crop. [3]

.....

.....

.....

.....

.....

.....

.....



**F3.** (a) Outline **one** example of a veterinary technique that has been used to improve the fecundity of animals. [2]

.....  
.....  
.....  
.....

(b) Discuss the use and misuse of growth hormones in livestock production. [3]

.....  
.....  
.....  
.....  
.....  
.....  
.....





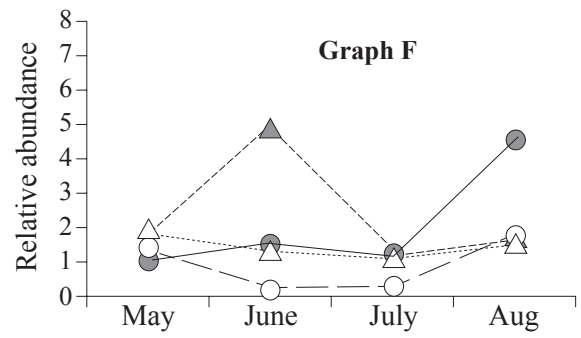
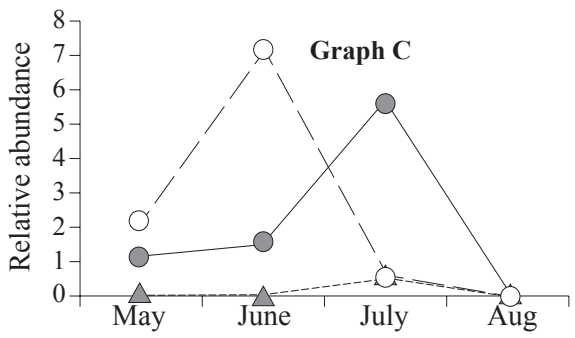
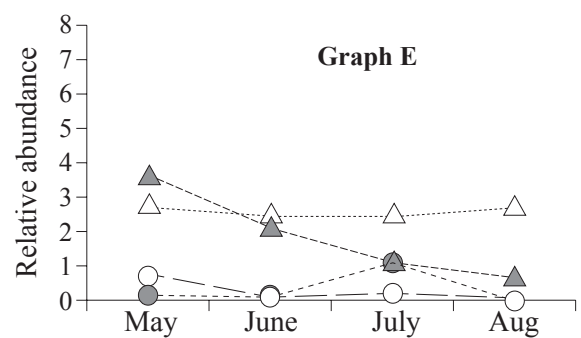
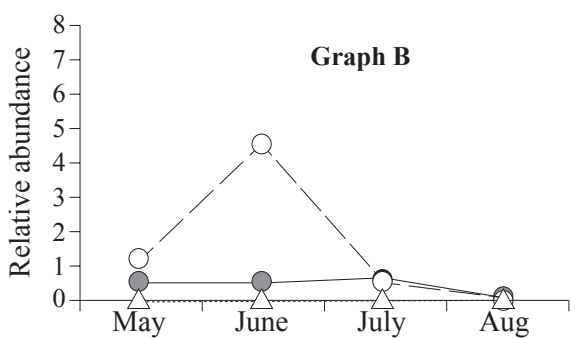
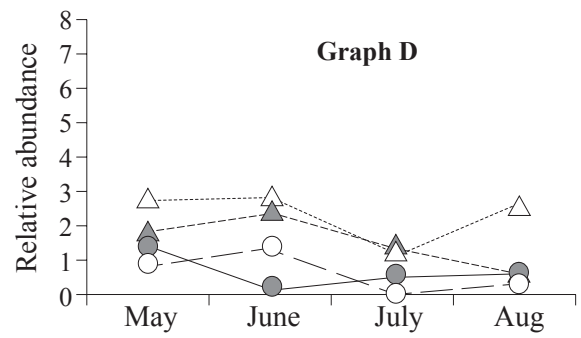
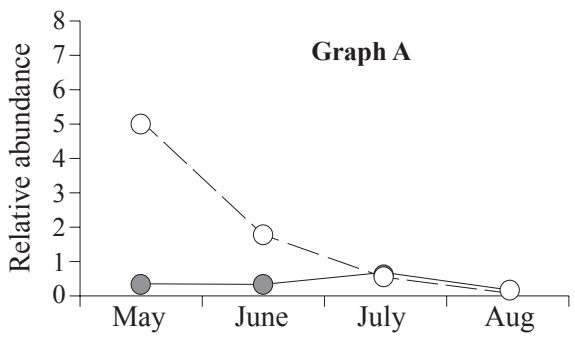
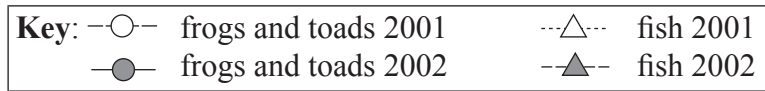
Blank page



**Option G — Ecology and Conservation**

**G1.** Obtaining information on movement and spatial patterns of animals and understanding the factors that influence their movements are critical in designing conservation strategies. Ecologists carried out a study of the threatened copper belly water snake (*Nerodia erythrogaster neglecta*) in northwest Ohio and southern Michigan to assess differences in movement patterns, spatial ecology and resource use.

The snakes feed on fish, frogs and toads found in wetland pools. The graphs below show the relative abundance of frogs, toads and fish in 2001 and 2002 for six wetlands at the study site. Graphs A, B and C correspond to temporary wetlands, and graphs D, E and F correspond to permanent wetlands.



[Source: adapted from J H Roe, et al. (2004), *Biological Conservation*, 118, pages 79–89, ©Elsevier 2004]

(This question continues on the following page)



(Question G1 continued)

(a) Identify the type of wetland that

(i) had the greatest frog and toad abundance during August. [1]

.....

(ii) had the most stable fish population. [1]

.....

(b) Deduce, giving a reason, which type of wetland is likely to provide the best food supply for the snakes. [2]

.....  
.....  
.....  
.....

(c) Changing land use is decreasing the numbers of wetlands. Suggest what impacts such changes in habitat may have on *N. erythrogaster neglecta*. [3]

.....  
.....  
.....  
.....  
.....  
.....  
.....  
.....



**G2.** (a) Define the term *ecological succession*. [1]

.....  
.....

(b) Outline **one** example of ecological succession. [2]

.....  
.....  
.....

(c) Explain the impact of living organisms with respect to a **named** example of ecological succession. [3]

.....  
.....  
.....  
.....  
.....  
.....

**G3.** (a) Outline the factors that led to the extinction of a **named** plant species in recent times. [2]

.....  
.....  
.....

(b) Suggest how the use of biotic indices could be used to prevent extinctions. [3]

.....  
.....  
.....  
.....  
.....  
.....

