IB DIPLOMA PROGRAMME
PROGRAMME DU DIPLÔME DU BI
PROGRAMA DEL DIPLOMA DEL BI

N05/4/BIOLO/SP3/ENG/TZ0/XX+

88056006

BIOLOGY
STANDARD LEVEL
PAPER 3

Friday 11 November 2005 (morning)

1 hour

Candidate session number

0	0							

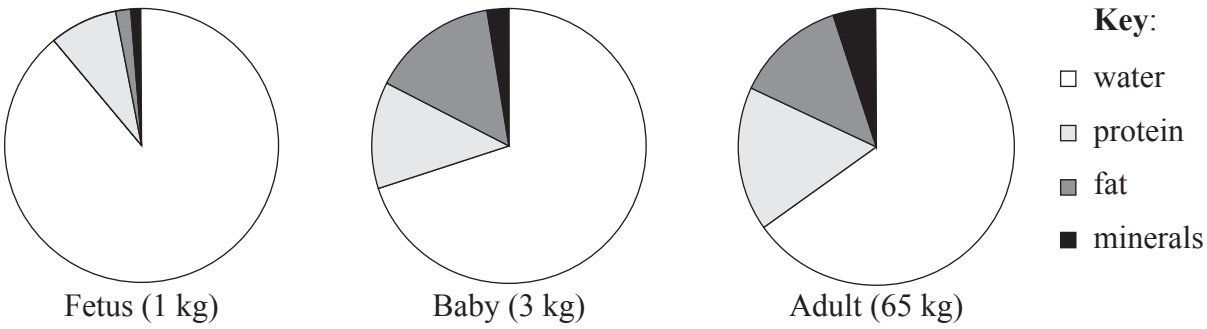
INSTRUCTIONS TO CANDIDATES

- 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 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.

0124

Option A — Diet and Human Nutrition

A1. Analyses of the human body show that its composition varies at different stages of life, so nutrient requirements may change according to age. The pie charts show the percentage of water, protein, fat and minerals that make up the body in the human fetus, a baby and in an adult.



[Source: Adapted from A Walker, (1999), *Human Nutrition*, Cambridge University Press, page 5]

(a) Estimate the percentage of the total mass of the fetus that is water. *[1]*

. . . . . .

(b) The chart shows that 15 % of the mass of the baby is fat. Calculate the mass of fat found in the baby. *[1]*

. . . . . .

(c) State in which stage of life the greatest total mass of water is found. *[1]*

. . . . . .

(d) Compare the percentage body composition of babies with adults. *[2]*

. . . . . .

. . . . . .

. . . . . .

. . . . . .

(e) Suggest **two** reasons for the change in fat composition shown in the pie chart from fetus to baby. *[2]*

. . . . . .

. . . . . .

. . . . . .

. . . . . .

A2. (a) Compare the diets of vegans and vegetarians by indicating which food they might eat by means of a tick (✓). *[2]*

	Milk	Egg	Beef	Potato
Vegan				
Vegetarian				

(b) Discuss the possibility of vitamin deficiency in the diet of a vegan. *[2]*

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

A3. (a) Define the term *diet*. *[1]*

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

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

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

(c) Discuss the relationship between nutrition and anemia. *[4]*

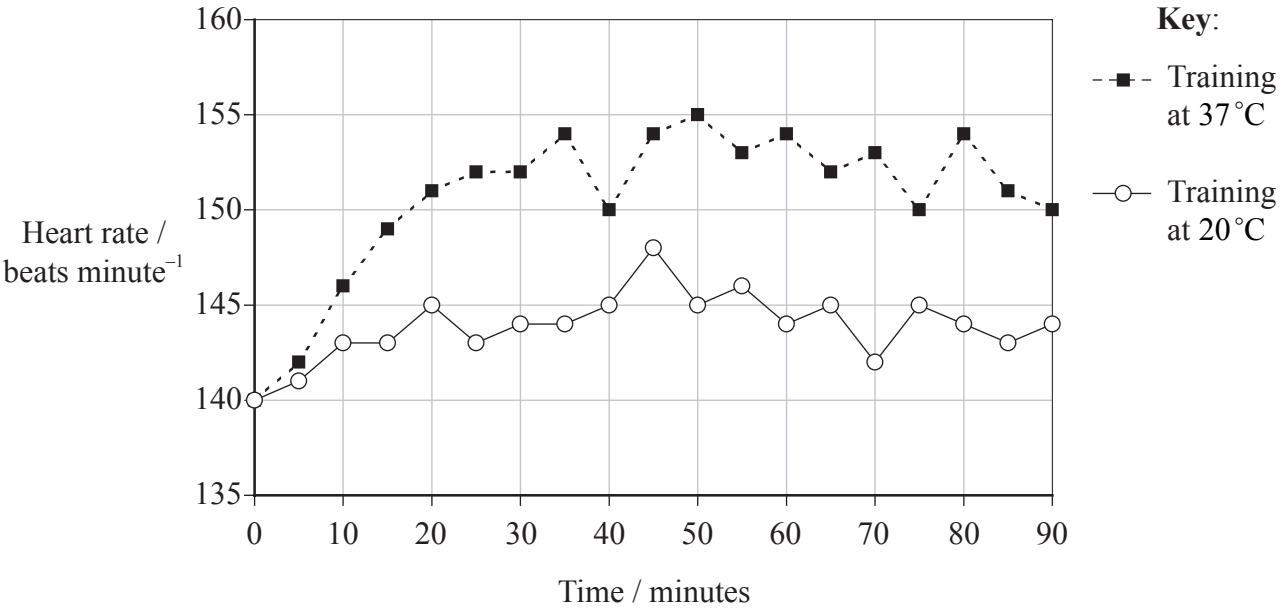
. . . . . .
. . . . . .
. . . . . .
. . . . . .
. . . . . .
. . . . . .
. . . . . .
. . . . . .
. . . . . .
. . . . . .

Option B — Physiology of Exercise

B1. Tests were carried out on ten male cyclists to see if training at higher than normal temperatures improved their fitness. The cyclists were divided in to two groups, A and B. Their training schedules were as follows:

Days 1 to 12	Group A and Group B train at 20 °C
Days 13 to 19	Group A trained at 20 °C and group B trained at 37 °C
Day 20	Group A and Group B have their heart rate measured during a time trial
Days 21 to 32	Group A and Group B train at 20 °C
Days 33 to 39	Group B trained at 20 °C and group A trained at 37 °C
Day 40	Group A and Group B have their heart rate measured during a time trial.

The graph below shows the average results of the time trial on days 20 and 40 for the cyclists. In both trials the cyclists had to cycle 40 km in exactly 90 minutes at 20 °C, with their heart rate being measured every 5 minutes.



(a) State the time of the highest heart rate reached by the cyclists training at 37 °C. *[1]*

. . . . . .

(b) State the heart rate of the cyclists training at 20 °C after 50 minutes. *[1]*

. . . . . .

(This question continues on the following page)

(Question B1 continued)

(c) Compare the results for the heart rate at each training temperature. *[3]*

. . . . . .

. . . . . .

. . . . . .

. . . . . .

. . . . . .

(d) Discuss whether the results support the hypothesis that training at high temperatures improves cardiovascular fitness. *[2]*

. . . . . .

. . . . . .

. . . . . .

. . . . . .

. . . . . .

(e) Suggest why on days 33 to 39, both Group A and Group B trained at different temperatures from the temperature they trained at from Days 13 to 19. *[1]*

. . . . . .

B2. (a) State the type of muscle fibres that would be found in higher percentages in well trained marathon runners. *[1]*

. . . . . .

(b) Explain why this type of muscle fibre is suitable in marathon runners. *[3]*

. . . . . .

. . . . . .

. . . . . .

. . . . . .

. . . . . .

. . . . . .

. . . . . .

B3. (a) Outline why a warm-up is needed before beginning exercise sessions. *[2]*

. . . . . .

. . . . . .

. . . . . .

(b) Explain how muscle fatigue can occur during exercise. *[4]*

. . . . . .

. . . . . .

. . . . . .

. . . . . .

. . . . . .

. . . . . .

. . . . . .

. . . . . .

. . . . . .

Blank page

Option C — Cells and Energy

C1. Studies were carried out on the leaves of the wild type of the flowering mustard plant (*Arabidopsis thaliana*) to determine the pigment composition of the thylakoid membrane. The results were compared with the leaves of a mutant strain of the plant. These studies were repeated using thylakoid membranes from leaves grown in cultures deficient in either iron or magnesium.

Strain of Plant	Mineral Deficiency	Chlorophyll / $\mu g\ g^{-1}$ leaf	Carotenoids / $\mu g\ g^{-1}$ leaf
Wild Type	None	454	16
	Iron	441	71
	Magnesium	317	64
Mutant	None	387	67
	Iron	317	81
	Magnesium	172	95

[Source: Lu *et al*., (1995), *Botanical Bulletin of Academia Sinica*, **36**, pages 175–179]

(a) State the concentration of chlorophyll found in the leaves of the mutant strain of plant when deficient in iron. *[1]*

. . . . . .

(b) (i) Calculate the percentage increase in carotenoids found in the wild type when magnesium is deficient. *[1]*

. . . . . .

(ii) Suggest why magnesium deficiency causes the changes shown in the pigment content of the leaves. *[2]*

. . . . . .

. . . . . .

. . . . . .

. . . . . .

(c) Using the data in the table, outline the effects of iron deficiency on the pigment content of the leaves. *[2]*

. . . . . .

. . . . . .

. . . . . .

. . . . . .

C2. (a) Distinguish between oxidation and reduction reactions. *[2]*

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

(b) State where in the mitochondrion the enzymes for Krebs cycle are found. *[1]*

. . . . . .

(c) Outline the processes involved in the Krebs cycle. *[4]*

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

C3. (a) Define the term *metabolic pathway*. *[1]*

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

(b) State the name of the bonds used to form the primary structure of a protein. *[1]*

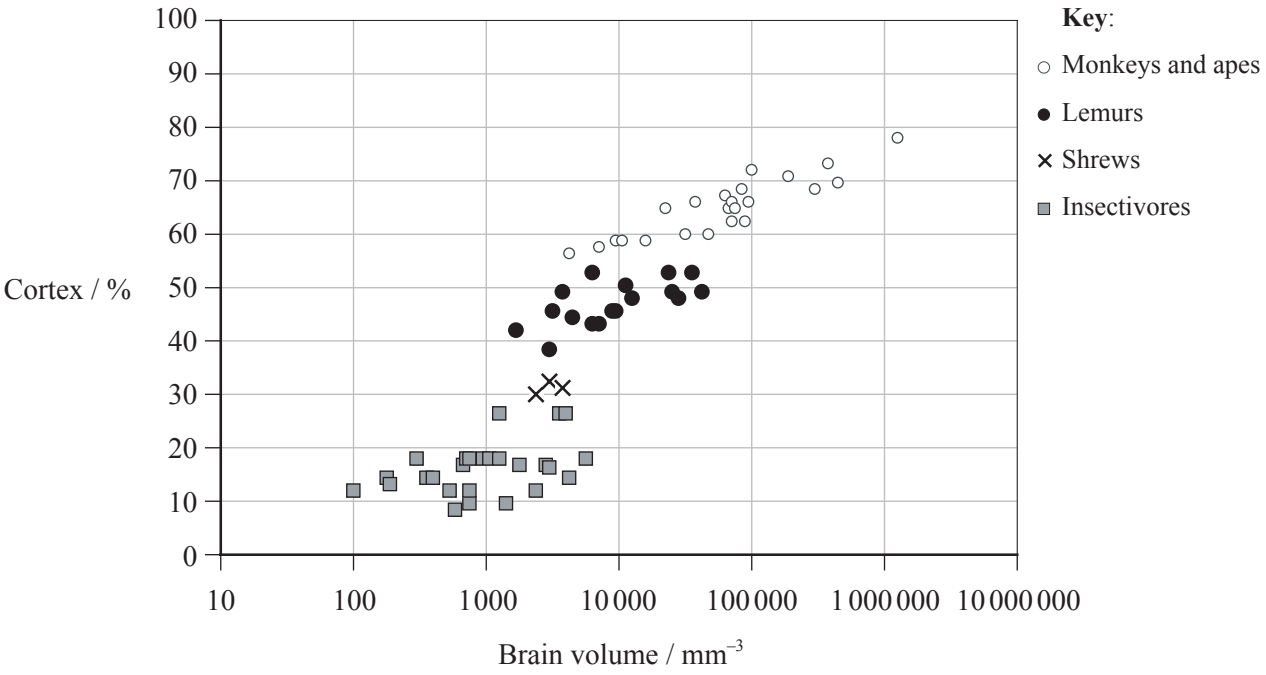
. . . . . .

(c) Compare the action of competitive and non-competitive enzyme inhibitors. *[3]*

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

Option D — Evolution

D1. Modern day primates are thought to have evolved from shrews and insectivores. Measurements of the brains of various species from which primates evolved show that the percentage of the brain that is cortex, differs between species. The graph shows this data for four different groups of species.



[Source: D A Clark *et al.*, (2001), *Nature*, **411**, pages 189–193]

(a) A species has a brain volume 1000 mm^{-3} of which 18 % is cortex. State which group it is likely to belong to. *[1]*

. . . . . .

(b) State the lowest percentage of brain cortex among the shrews studied. *[1]*

. . . . . .

(c) Using the graph, compare insectivores with lemurs. *[2]*

. . . . . .

. . . . . .

. . . . . .

. . . . . .

. . . . . .

(This question continues on the following page)

(Question D1 continued)

(d) (i) Using the letter H, label the graph to show which point represents *Homo sapiens*. *[1]*

(ii) Explain the reasons for your choice in (i). *[1]*

. . . . . .

. . . . . .

D2. (a) State the class in which human beings are placed. *[1]*

. . . . . .

(b) Describe some of the physical features that define human beings as primates. *[3]*

. . . . . .

. . . . . .

. . . . . .

. . . . . .

(c) State **two** differences and **one** similarity between genetic and cultural evolution. *[3]*

Difference 1: . . . . . .

. . . . . .

Difference 2: . . . . . .

. . . . . .

Similarity: . . . . . .

. . . . . .

D3. (a) Outline the possible role of clay molecules in polymerisation reactions early in the origin of life. *[2]*

. . . . . .

. . . . . .

. . . . . .

. . . . . .

(b) Discuss the possible importance of RNA in the formation of macromolecules in the origin of life. *[3]*

. . . . . .

. . . . . .

. . . . . .

. . . . . .

. . . . . .

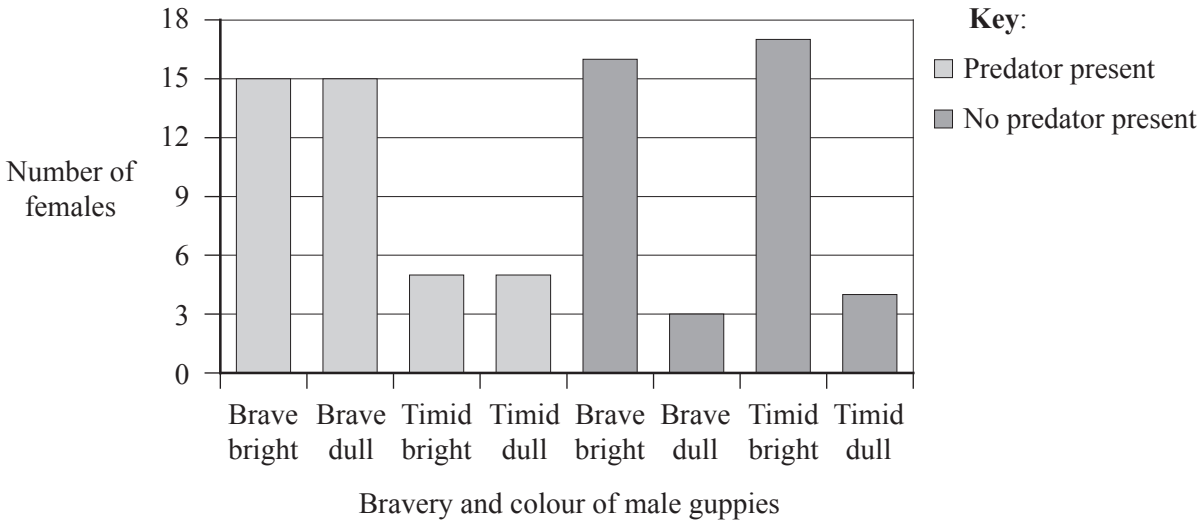
. . . . . .

. . . . . .

Blank page

Option E — Neurobiology and Behaviour

E1. The guppy (*Poecilia reticulata*) is a small fish commonly found in Trinidad. In an experiment, male guppies were divided into those with a lot of colour (bright) and those with little colour (dull). They were also exposed to a predator to see if they approached it (brave) or swam away from it (timid). Female guppies were allowed to select males to mate with, in the presence and absence of predators. The bar chart summarizes their choice of males.



[Source: J G Godin and L A Dugatkin, (1996), *Proc. National Academy Science*, *USA*, **93**, pages 10262–10267]

(a) State how many females chose dull male guppies with a predator present. *[1]*

. . . . . .

(b) Calculate the difference in timid bright males chosen by the females with and without the predator present. *[1]*

. . . . . .

. . . . . .

(This question continues on the following page)

(Question E1 continued)

(c) (i) Compare mate selection by females in the presence and absence of a predator. *[2]*

. . . . . .

. . . . . .

. . . . . .

. . . . . .

(ii) Suggest reasons for this pattern of mate selection. *[2]*

. . . . . .

. . . . . .

. . . . . .

. . . . . .

(d) Evaluate the hypothesis that bravery is more important than colour to females when selecting a mate. *[2]*

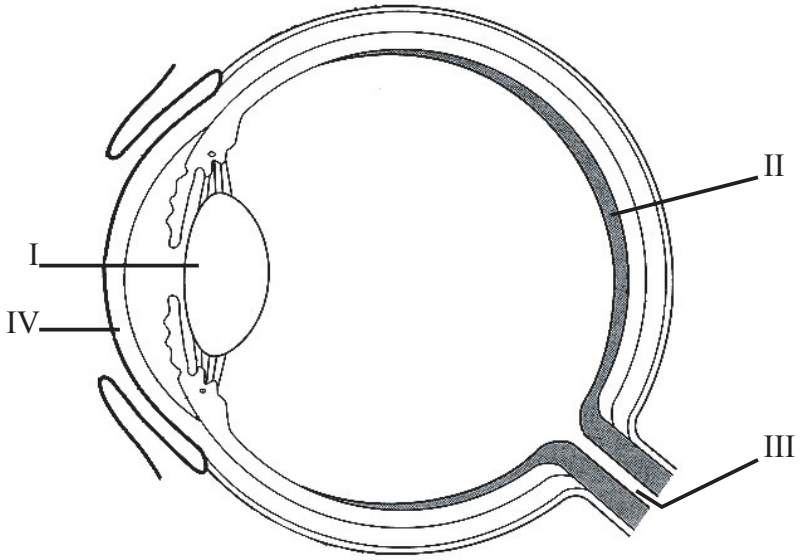
. . . . . .

. . . . . .

. . . . . .

. . . . . .

E2. (a) Identify the parts labelled I to IV on the diagram of the eye shown below. *[2]*



I: . . . . . .

II: . . . . . .

III: . . . . . .

IV: . . . . . .

(b) State the class of human sensory receptor found in the retina of the eye. *[1]*

. . . . . .

(c) Outline how the visual stimuli is processed by the retina and brain. *[2]*

. . . . . .

. . . . . .

. . . . . .

. . . . . .

. . . . . .

E3. (a) Define the term *operant conditioning*. *[1]*

. . . . . .

. . . . . .

(b) Distinguish between the terms *taxis* and *kinesis*. *[1]*

. . . . . .

. . . . . .

. . . . . .

(c) Discuss how learning may contribute to an organism's survival chances. *[3]*

. . . . . .

. . . . . .

. . . . . .

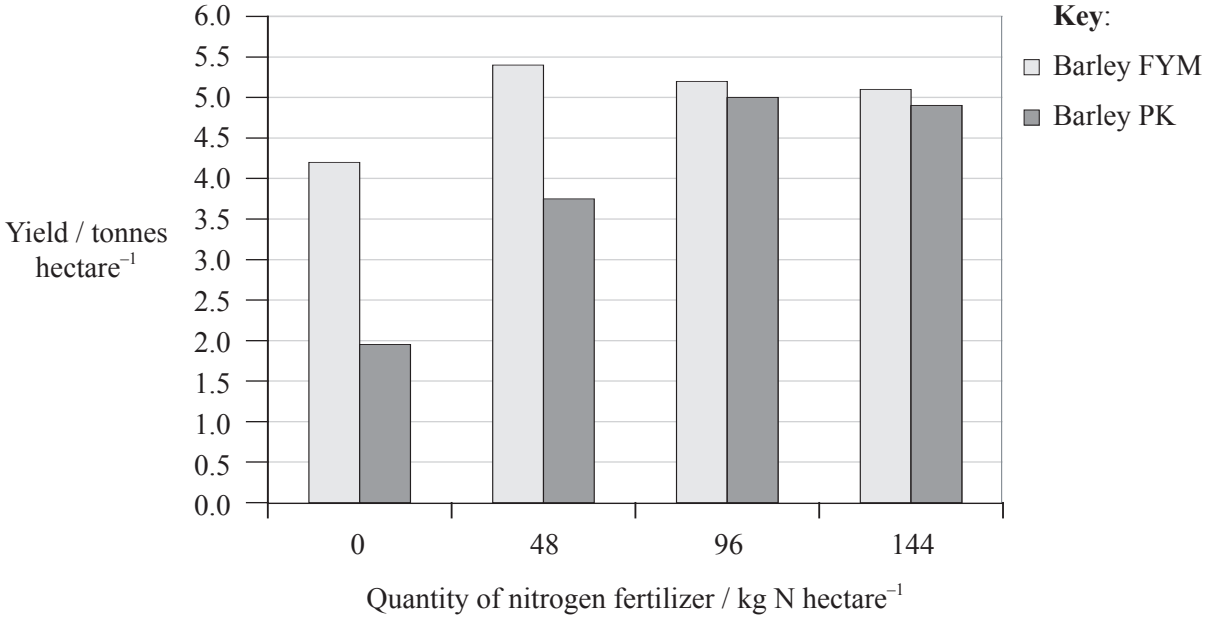
. . . . . .

. . . . . .

. . . . . .

Option F — Applied Plant and Animal Science

F1. The yield of barley was measured when given different fertilizers. The cereal was treated either with phosphorus and potassium salts (PK) or with farmyard manure (FYM). The experiment was repeated while increasing the quantities of nitrogen (N) fertilizer in the soil.



[Source: MPC research, (2001), *Basic Integrated Agri-Management Syllabus*, part 2a, MPC Research]

(a) State the barley yield when the crop was fertilized with phosphorous and potassium at 48 kg N hectare^{-1}. *[1]*

. . . . . .

(b) State the amount of nitrogen in the soil at which the greatest total yield of barley was obtained. *[1]*

. . . . . .

(c) Describe the effect of increasing the amount of nitrogen fertilizer on the yield of barley with PK fertilizer. *[2]*

. . . . . .

. . . . . .

. . . . . .

. . . . . .

(This question continues on the following page)

(Question F1 continued)

(d) With the help of the data, evaluate the benefits of farmyard manure as a fertilizer. *[3]*

. . . . . .

. . . . . .

. . . . . .

. . . . . .

. . . . . .

. . . . . .

F2. (a) State **one** type of animal used for plowing and **one** type of animal used for transport. *[1]*

Plowing: . . . . . .

Transport: . . . . . .

(b) State **one** advantage and **one** disadvantage of using antibiotics in livestock production. *[2]*

Advantage: . . . . . .

. . . . . .

Disadvantage: . . . . . .

. . . . . .

(c) Outline, using **one** example, how animal breeding programmes have increased yield. *[2]*

. . . . . .

. . . . . .

. . . . . .

. . . . . .

F3. (a) State **two** factors affecting plant productivity that can be controlled by a greenhouse. *[2]*

. . . . . .

. . . . . .

(b) Evaluate monoculture as a method of crop production. *[4]*

. . . . . .

. . . . . .

. . . . . .

. . . . . .

. . . . . .

. . . . . .

. . . . . .

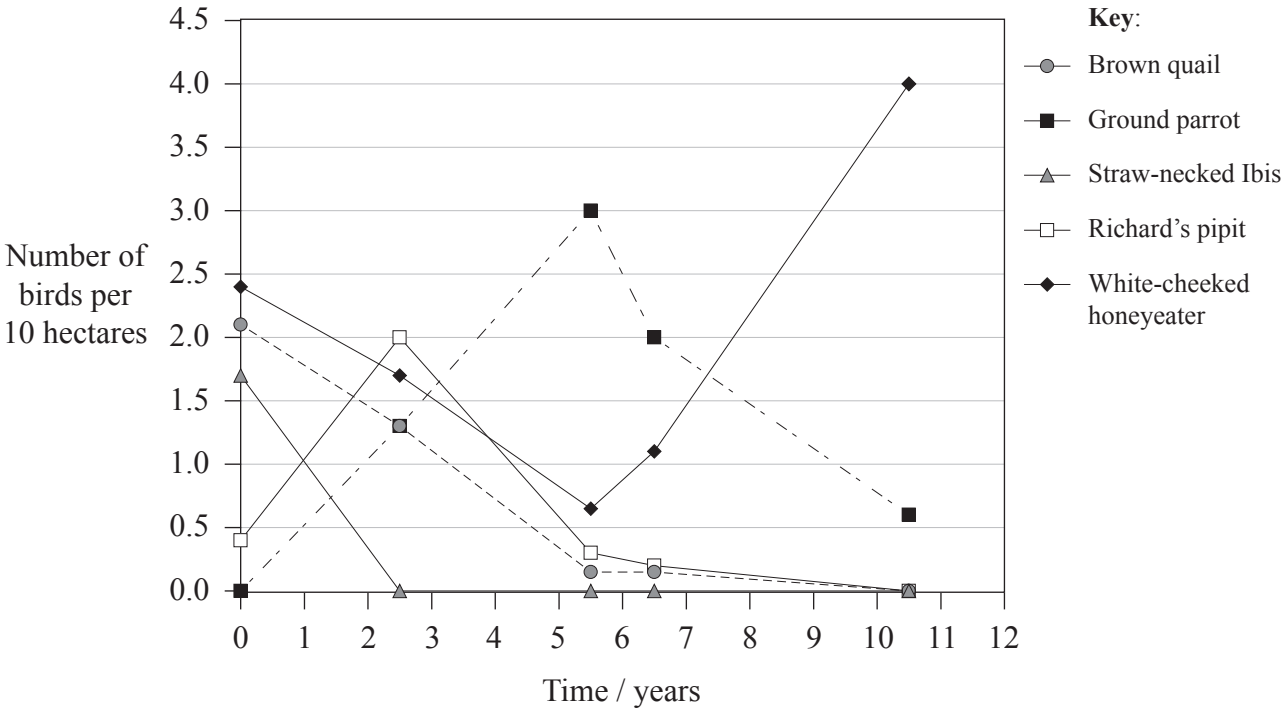
. . . . . .

. . . . . .

Blank page

Option G — Ecology and Conservation

G1. In Australia, studies were performed on wild grassland sites containing shrubs to determine the effect that fires have on the biodiversity of birds living there. The birds occupy different habitats in the ecosystem, and each is affected differently by the fires. Counts were made of the numbers of birds of several species immediately before the fire, and then at intervals in the following years.



[Source: A M Gill *et al.*, (1999), *Australia's Biodiversity – Responses to Fire, Plant, Birds and Invertebrates*, Australian Government Department of the Environment and Heritage, page 1999]

(a) State the time after the fire before the greatest number of ground parrots was found. *[1]*

. . . . . .

(b) The white-cheeked honeyeater eats nectar from flowering plants. Using the data, predict the effect the fire had on these flowering plants. *[2]*

. . . . . .

. . . . . .

. . . . . .

. . . . . .

(This question continues on the following page)

(Question G1 continued)

(c) Immediately before the fire (0 years), the Simpson diversity index for 10 hectares of the ecosystem was 5.4. Predict, giving a reason, whether you would expect this value to increase, decrease or remain unchanged 10.5 years after the fire. *[2]*

. . . . . .

. . . . . .

. . . . . .

. . . . . .

(d) Suggest **two** reasons why the results varied for the different bird species. *[2]*

1. . . . . .

. . . . . .

2. . . . . .

. . . . . .

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

. . . . . .

. . . . . .

(b) State **two** organisms that interact together by mutualism. *[1]*

1. . . . . .

2. . . . . .

(c) Explain why the biomass of species at higher trophic levels tends to be small. *[3]*

. . . . . .

. . . . . .

. . . . . .

. . . . . .

. . . . . .

. . . . . .

. . . . . .

G3. (a) A researcher measured the mean size of leaves from two trees of the same species in different habitats. State **one** statistical test used to see if there is a significant difference in the leaf size. *[1]*

. . . . . .

(b) Outline **two** important tasks in managing nature reserves. *[2]*

. . . . . .

. . . . . .

. . . . . .

. . . . . .

(c) Explain the principle of competitive exclusion. *[3]*

. . . . . .

. . . . . .

. . . . . .

. . . . . .

. . . . . .

. . . . . .

. . . . . .