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BIOLOGY
STANDARD LEVEL
PAPER 3

Tuesday 18 November 2008 (morning)

1 hour

Candidate session number

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INSTRUCTIONS TO CANDIDATES

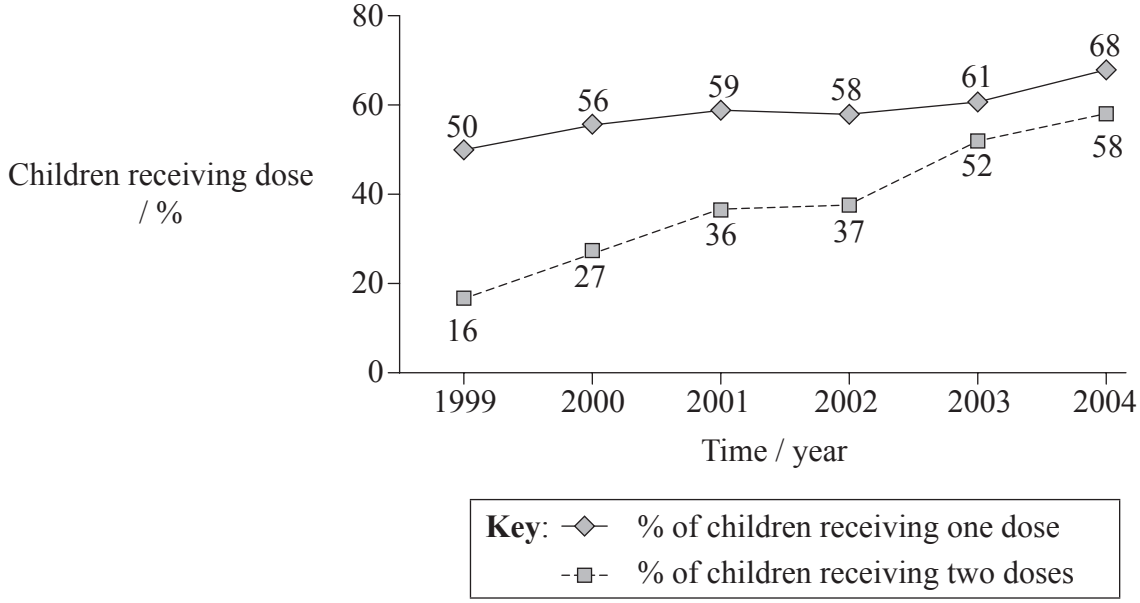
- Write your session number in the boxes above.
- Do not open this examination paper until instructed to do so.
- Answer all of the questions from two of the Options in the spaces provided. You may continue your answers on answer sheets. Write your session number on each answer sheet, and attach them 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.

0129

Option A — Diet and Human Nutrition

A1. Retinol (vitamin A) is essential for healthy development in children. The United Nations Children's Emergency Fund (UNICEF) estimates that 70 % of children around the world need retinol supplements to prevent any developmental problems.

The graph below shows the percentage of children receiving one or two doses of retinol per year between 1999 and 2004.



[Source: adapted from UNICEF 2006, http://www.childinfo.org/areas/vitamina/]

(a) State the years between which the increase in children receiving the two-dose supplement is greatest. *[1]*

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(b) Suggest **one** possible reason why this data may be incomplete. *[1]*

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(This question continues on the following page)

(Question A1 continued)

(c) Analyse the trend in the proportion of children receiving supplements of retinol from 1999 to 2004. *[3]*

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(d) Outline the effects of low retinol in the diet. *[2]*

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A2. (a) (i) Carbohydrates are one of the constituents of a diet. List **three** other constituents of a diet. *[1]*

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2. . . . . .

3. . . . . .

(ii) In the table below, state **one** example and **one** natural source of disaccharides and polysaccharides. *[2]*

Carbohydrates	Example	Natural source
Disaccharides		
Polysaccharides		

(b) Discuss the factors that affect energy requirements in humans. *[3]*

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A3. (a) (i) State **two** types of food additives. *[1]*

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(ii) Outline **one** possible harmful effect of a **named** food additive. *[2]*

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(b) Distinguish between vegan and vegetarian diets. *[2]*

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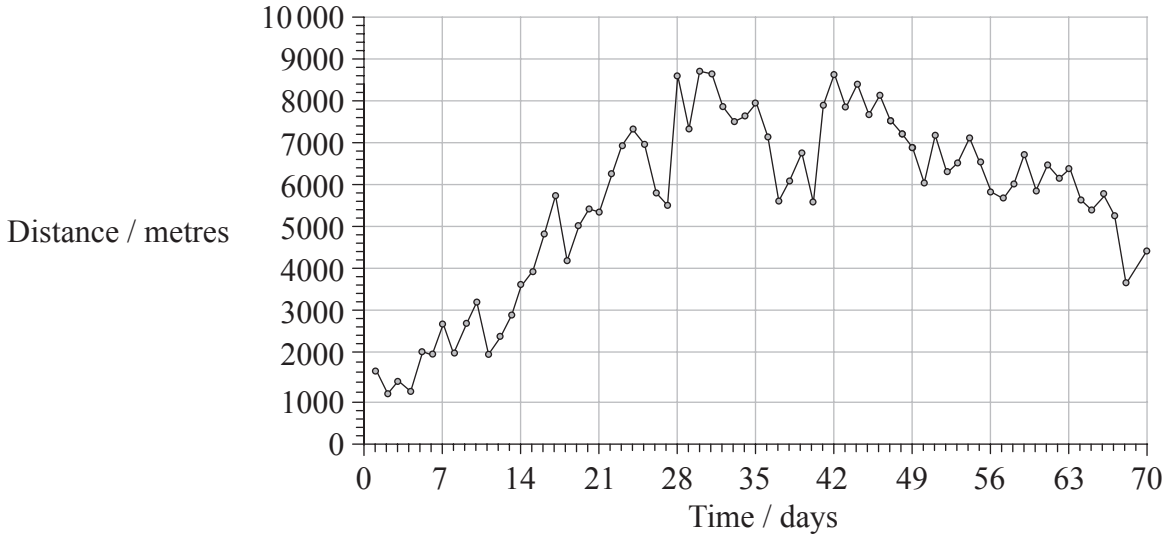
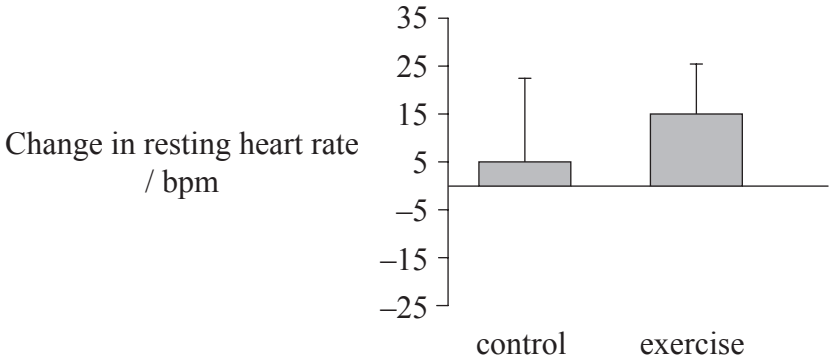
Option B — Physiology of Exercise

B1. A study was performed on rats with high blood pressure to investigate the effects of exercise on the cardiovascular function. For a period of ten weeks, the rats were exercised using a treadmill or allowed free access to running wheels. At the same time other rats were kept as controls under non-exercise conditions.

Graph A: Shows the average distances rats ran per day



Graph B: Shows the mean changes in the resting heart rate in all groups between the beginning and the end of the experiment



[Figures 1 and 2 from Jeffery M Kramer, Joseph A Beatty, Hugh R Little, Edward D Plowey and Tony G Waldrop, "Chronic exercise alters caudal hypothalamic regulation of the cardiovascular system in hypertensive rats", *American Journal of Physiology: Regulatory, Integrative and Comparative Physiology*, vol. 280 (2) (pp. 389-97) Fig. 1 (p. 391) Fig. 2 (p. 392). Copyright © 2001 by American Physiological Society. Reproduced with permission of American Physiological Society.]

(a) It was observed that rats ran on average twenty metres per minute. Calculate how many minutes the rats ran on day 35 of the experiment. *[1]*

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(Question B1 continued)

(b) Describe the trends in **Graph A** during the period of the experiment. *[3]*

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(c) Evaluate the changes in heart rate between the exercise and control group. *[2]*

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B2. (a) (i) State which type of neuron stimulates skeletal muscle to contract. *[1]*

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(ii) Explain how skeletal muscle contracts. *[3]*

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(b) Flexibility and agility are used to measure fitness. Discuss other measurements that could be used to measure fitness. *[2]*

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B3. (a) Outline the role of myoglobin in muscles. *[3]*

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(b) (i) Describe sprain injuries. *[2]*

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(ii) State **two** other types of injuries that affect muscles and joints. *[1]*

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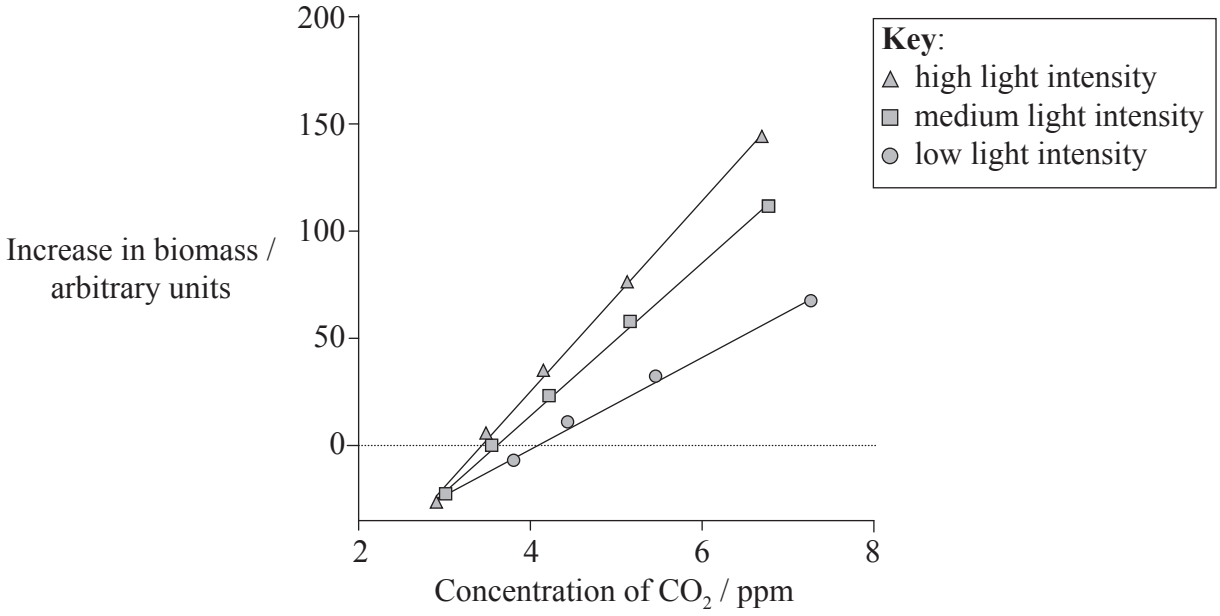
Option C — Cells and Energy

C1. Experiments were conducted to study photosynthesis at different CO_2 concentrations in bluegrass, *Poa compressa*. The grass was grown at a constant temperature of 20 °C but under different light intensities. The graph below shows the increase in biomass versus concentration of CO_2 in the grass.



[Adapted from O K Atkin et al., "Leaf Respiration in Light and Darkness: A Comparison of Slow- and Fast-Growing Poa Species", *Plant Physiology*, vol. 113 (pp. 961–965), Fig. 1 on page 963. © American Society of Plant Biologists]

(a) (i) Describe the relationship between the increase in biomass and the concentration of CO_2. *[2]*

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(ii) Distinguish between the increase in biomass at low light intensity and high light intensity. *[2]*

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(This question continues on the following page)

(Question C1 continued)

(b) Discuss how an increase in temperature would affect the biomass in this experiment. *[2]*

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C2. (a) Explain non-competitive inhibition using a **named** example. *[3]*

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(b) State the part of the cell in which glycolysis occurs. *[1]*

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(c) Describe the role of acetyl CoA in metabolism. *[3]*

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C3. (a) Draw and label the structure of a chloroplast as seen under an electron microscope. *[3]*

(b) Explain the relationship between the structure of the chloroplast and its function. *[2]*

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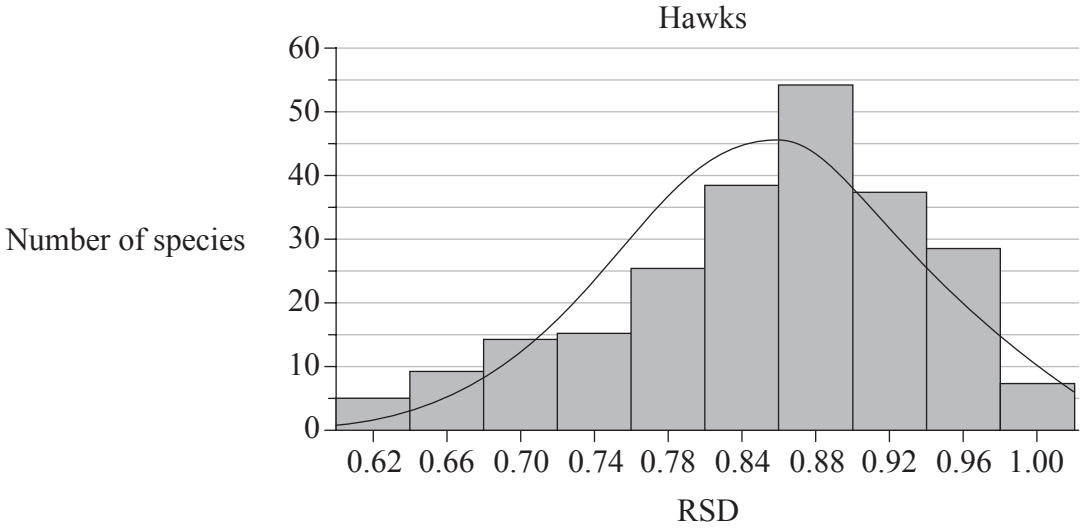
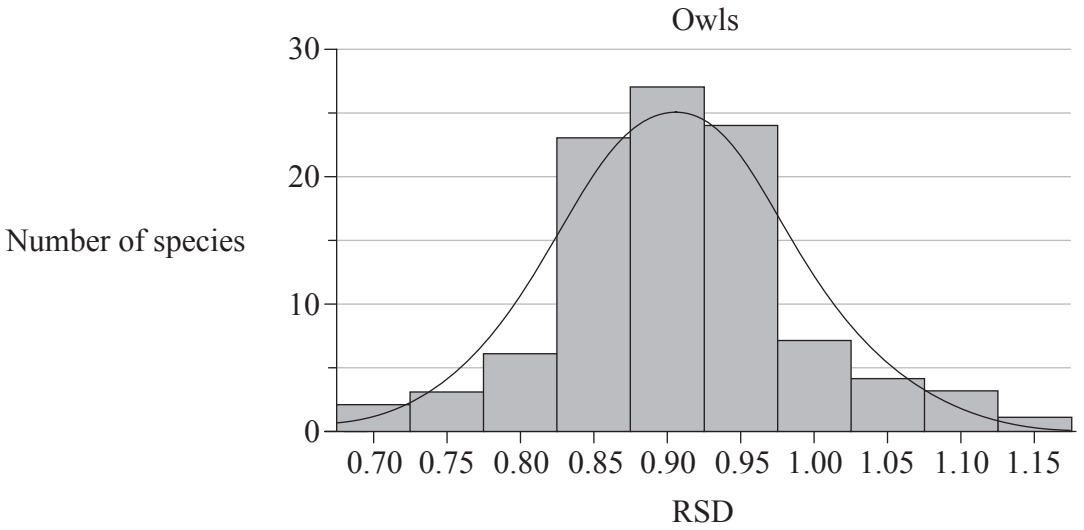
Option D — Evolution

D1. In most animal species males are bigger than females. However, in hawks and owls females are larger than males, which is called reverse size dimorphism (RSD). The RSD value is calculated by dividing the wing length of males (mm) by the wing length of females (mm). An RSD value of 1 indicates no difference between male and female size.

The graphs below show the RSD values for 237 species of hawk and 212 species of owl. The lines show the normal distribution.





[O Krüger, "The Evolution of Reversed Sexual Size Dimorphism in Hawks, Falcons and Owls: A Comparative Study", *Evolutionary Ecology*, vol. 19 (5) pages 467–86. © 2005. With kind permission from Springer Science and Business Media.]

(This question continues on the following page)

(Question D1 continued)

(a) (i) State which animal has a wider range of RSD values. *[1]*

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(ii) Calculate the number of hawk species that have an RSD of 0.70 **or** lower. *[1]*

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(b) Compare the RSD values for hawks and owls. *[2]*

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(c) Suggest possible reasons to explain the evolution and maintenance of RSD values in hawks and owls. *[2]*

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D2. (a) The temperature of pre-biotic Earth is believed to have been very high. State **two** other conditions thought to have been present on the pre-biotic Earth. *[1]*

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

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(c) Discuss the endosymbiotic theory for the origin of eukaryotes. *[3]*

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D3. (a) Outline Lamarck's theory of evolution. *[3]*

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(b) State the class, order and family of humans. *[2]*

Class: . . . . . .

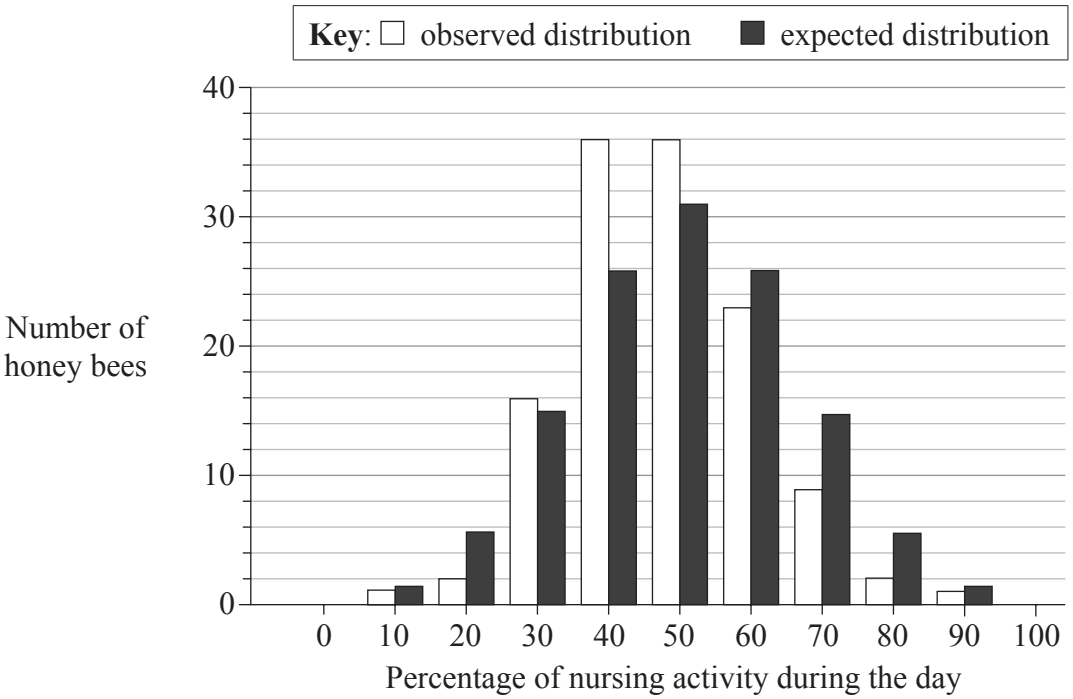
Order: . . . . . .

Family: . . . . . .

Option E — Neurobiology and Behaviour

E1. Nursing (taking care of larvae) patterns in honey bees have been monitored in glass-walled observation hives at regular intervals during a twenty-four hour period.

On the graph below a value of 100 % indicates only day-time nursing activity and 0 % indicates only night-time nursing activity.



[Adapted from Gene Robinson, "From Society to Genes with the Honey Bee", *American Scientist*, vol. 86 (5), page 456. Reprinted by permission of *American Scientist*, magazine of Sigma Xi, The Scientific Research Society.]

(a) (i) Calculate the difference in the number of honey bees, observed and expected, at 60 %. *[1]*

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(ii) Calculate the number of honey bees that carry out 30 % or less of their nursing activity during the day. *[1]*

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(This question continues on the following page)

(Question E1 continued)

(b) Analyse the nursing patterns of the honey bee in this experiment. *[3]*

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(c) In the social organization of honey bees, state the type of honey bee that carries out the nursing activity. *[1]*

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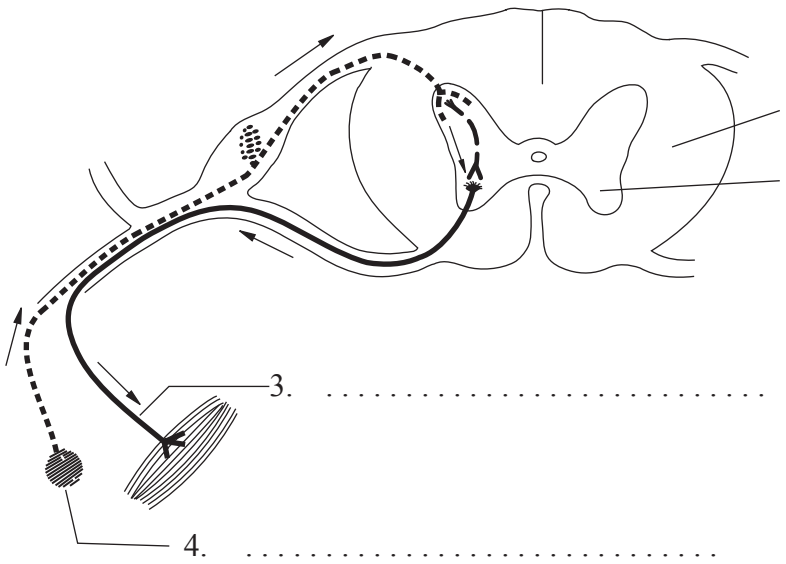
E2. The diagram below represents the spinal cord in cross section.



(a) (i) On the diagram above label the **four** components of a reflex arc. *[2]*

(ii) Outline a human spinal reflex (other than the pain withdrawal reflex). *[2]*

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(b) State the name of **three** examples of animals (other than humans) that show social behaviour. *[1]*

1. . . . . .

2. . . . . .

3. . . . . .

(c) Using the table below, distinguish between rod cells and cone cells. *[2]*

Rod cells	Cone cells

E3. (a) (i) State the type of behaviour that develops independently of the environment. *[1]*

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(ii) Explain, using a **named** example (other than humans), the behaviour of grooming. *[3]*

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

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Option F — Applied Plant and Animal Science

F1. Chickens are a significant source of food for the world's population. Chicken farming by individual families (non-commercial) has a low productivity rate. The table below compares family and commercial farming of chickens.

	Chicken farming	
	Family	**Commercial**
Age at mature weight / weeks	>24	<20
Egg production / eggs per hen per year	50	>60
Egg weight / g	40	>60
Mature weight / kg	1.4	>2
Annual mortality rate / %	>60	<20

The following table gives estimates of the production of chicken in families and their contribution to the total national production in several developing countries.

Country	**Number of chickens in family farms / ×1000**	**Family farmed chickens as percentage of national production / %**
Ethiopia	54 000	99
Malaysia	13 000	15
Nigeria	120 000	80
Sri Lanka	3 000	25
Uganda	16 000	80
Vietnam	200 000	98

[Sources: adapted from A J Kitalyi, *World Animal Review*, (1997), **89**(2), pages 48–53]

(a) Using the data from both tables, calculate the approximate egg production per year in Nigeria. *[1]*

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(This question continues on the following page)

(Question F1 continued)

(b) Compare the chicken production between Ethiopia and Nigeria. *[2]*

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(c) (i) Suggest **one** reason for the differences between family farming and commercial farming. *[1]*

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(ii) Using the data, discuss why governments advise against the family farming of chickens. *[2]*

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F2. (a) State **two** different uses of plants, other than for food, providing **one** plant example for each. *[2]*

Uses of plant	Named example

(b) Explain how the temperature in greenhouses can affect plant productivity. *[3]*

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F3. (a) (i) Define the term *inbreeding*. *[1]*

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(ii) Outline the concept of inbreeding using a plant example **or** an animal example. *[3]*

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(b) (i) State **two** commercial uses of plant hormones. *[1]*

1. . . . . .

2. . . . . .

(ii) Using a **named** example, describe **one** commercial use of plant hormones. *[2]*

Name of the plant . . . . . .

Name of the hormone . . . . . .

Effect/application technique . . . . . .

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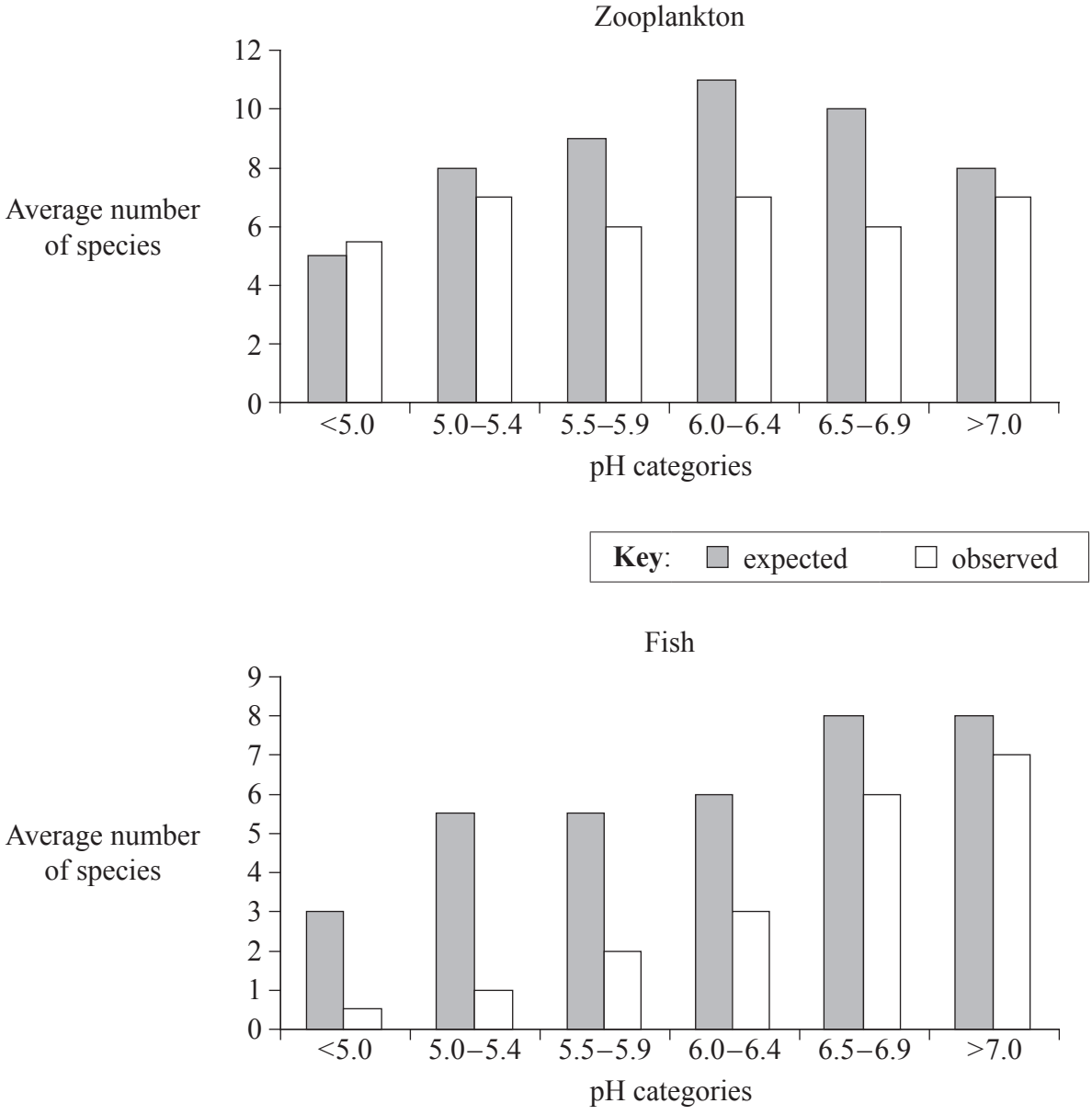
Option G — Ecology and Conservation

G1. Mining activities often affect the pH of nearby lakes. Data was collected on the observed and expected average number of species of zooplankton (small aquatic animals) and fish in lakes from a mining area. The expected numbers of species is based on values observed in lakes of a similar size in the same area but more distant from the mines.



[Source: adapted from J M Gunn, (1995), *Restoration and recovery of an industrial region*, Springer-Verlag, New York, page 264]

(This question continues on the following page)

(Question G1 continued)

(a) Identify which type of animal and pH range showed the highest difference between the expected and observed numbers. *[1]*

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(b) Compare the expected and observed values for fish. *[2]*

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(c) Analyse the effect of pH on zooplankton and fish. *[3]*

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G2. (a) State **three** abiotic factors that affect the distribution of plant species. *[1]*

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(b) In the table below, state **one** example for each type of interaction indicating the organisms involved. *[2]*

Type of interaction	Example
Herbivory	
Parasitism	
Mutualism	

(c) Construct a pyramid of energy with **three** trophic levels using organisms that you have studied in your course. *[3]*

G3. (a) State a species of plant **or** animal that has become extinct since 1600, and list **two** factors that help to explain why that species became extinct. *[3]*

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(b) Outline the use of **one** *ex-situ* conservation measure. *[2]*

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(c) Define the term *gross production*. *[1]*

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