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

N06/4/BIOLO/SP3/ENG/TZ0/XX+

88066006

BIOLOGY
STANDARD LEVEL
PAPER 3

Friday 17 November 2006 (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.

0122

Option A — Diet and Human Nutrition

A1. Data was collected on the diets of children in the United Kingdom. The table below compares the intake of three minerals in the diet with their Recommended Daily Allowance (RDA). The results also show the total percentage of children below the RDA, of which some (shown in brackets) are found to be well below the RDA.

		Iron		Calcium		Zinc	
	Age range / years	Average intake / % RDA	Total % of children below RDA	Average intake / % RDA	Total % of children below RDA	Average intake / % RDA	Total % of children below RDA
Boys	4 to 6	134	14 (0)	157	10 (3)	86	80 (12)
	7 to 10	111	40 (1)	135	19 (2)	88	73 (5)
	11 to 14	95	61 (3)	80	79 (12)	79	84 (14)
	15 to 18	111	44 (2)	88	68 (9)	82	69 (9)
Girls	4 to 6	119	28 (1)	146	15 (2)	77	91 (26)
	7 to 10	96	59 (3)	119	29 (5)	81	83 (10)
	11 to 14	60	98 (45)	80	79 (24)	66	97 (37)
	15 to 18	58	94 (50)	82	76 (19)	87	73 (10)

[Dietary Reference Values for Food, Energy and Nutrition for the UK. Source: National Diet and Nutrition Survey: Young People Aged 4 to 18 years, (SN 4243), 1997, UK Data Archive/Economic and Social Data Service.

(a) Identify the age range where the greatest percentage of girls are below the RDA in calcium intake. *[1]*

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(b) Calculate the percentage of boys in the 4 to 6 year age range obtaining zinc at, or above, the RDA level. *[1]*

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(c) Compare the average mineral intake of girls with boys in the 15 to 18 year age range. *[2]*

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(This question continues on the following page)

(Question A1 continued)

(d) Discuss why girls are more likely to develop anaemia as they get older. *[3]*

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A2. (a) State **one** food which is a suitable source of protein for a vegetarian. *[1]*

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(b) Distinguish between essential amino acids and other amino acids. *[1]*

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(c) Outline the fate of the products of excess proteins in the diet. *[3]*

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A3. (a) State the unit used to measure the energy content of food. *[1]*

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(b) Explain why adults may have different energy requirements. *[2]*

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(c) Discuss why high energy lipid diets **may** lead to health problems. *[3]*

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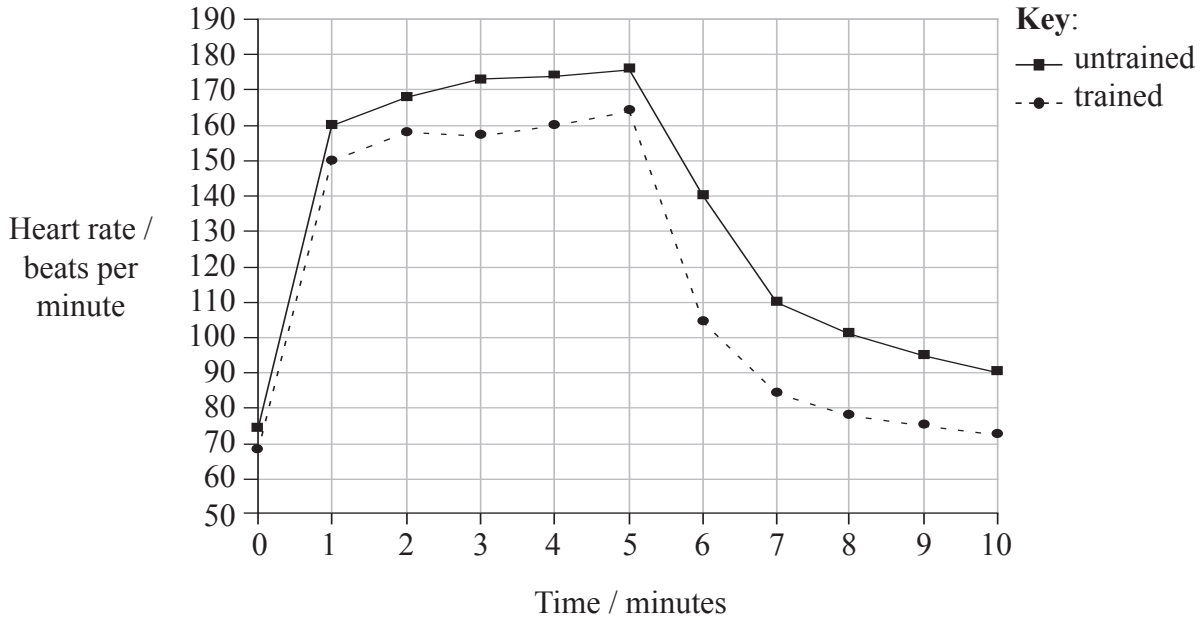
Option B — Physiology of Exercise

B1. Tests were carried out to determine how the cardiovascular system adapted to fitness training. Volunteers exercised heavily for five minutes during which time their heart rate was measured. The heart rate was also measured for five minutes after the exercise was completed (the recovery period). This process was repeated after a period of training. The graph below summarises the results before (untrained) and after the training (trained).



[Source: Robert Hockey, *Physical Fitness*, 1973, pages 68–70 © The McGraw-Hill Companies, Inc]

(a) Identify the heart rate for the untrained volunteers two minutes after completion of exercise. *[1]*

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(b) Analyse the effects of training on the heart rate. *[3]*

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(c) Deduce how the trained volunteers maintained the same blood volume to the muscles. *[1]*

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(This question continues on the following page)

(Question B1 continued)

(d) Outline the importance of the cardiovascular system during exercise. *[2]*

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B2. (a) State the function of synovial fluid in the human elbow joint. *[1]*

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(b) Outline how long bones are adapted to their functions. *[2]*

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(c) Explain the methods that can be used to treat injuries to muscles. *[3]*

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B3. (a) Outline how impulses are transmitted between neurons. *[2]*

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(b) Explain the role of the nervous system in the voluntary contraction of the biceps muscle. *[3]*

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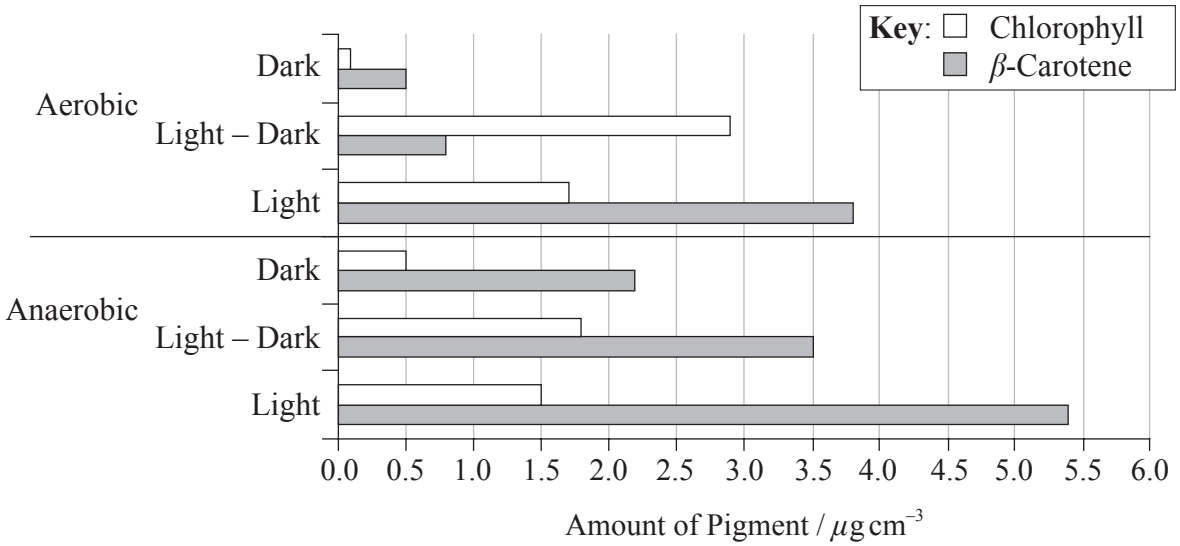
Option C — Cells and Energy

C1. The cyanobacterium *(Calothrix elenkenii)* is cultivated as a source of photosynthetic pigments for use in research and industry. The chart below shows the quantity of two of the pigments produced when exposed to a day of continuous dark, a day of 16 hours light and 8 hours dark and a day of continuous light. This was repeated in both aerobic and anaerobic conditions.



[Source: Reprinted from *Journal of Plant Physiology*, Vol 161, Parsanna *et al*., "Modulation of pigment…" pages 1125–1132, Copyright (2002), with permission from Elsevier.]

(a) Identify the light conditions that cause most chlorophyll to be made when the cyanobacterium is cultivated anaerobically. *[1]*

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(b) Calculate the percentage increase in chlorophyll grown anaerobically in the light, compared with anaerobically in the dark. *[1]*

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(c) Compare pigment production in different aerobic conditions. *[2]*

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(d) Discuss why having more than one photosynthetic pigment is an advantage to cyanobacterium. *[3]*

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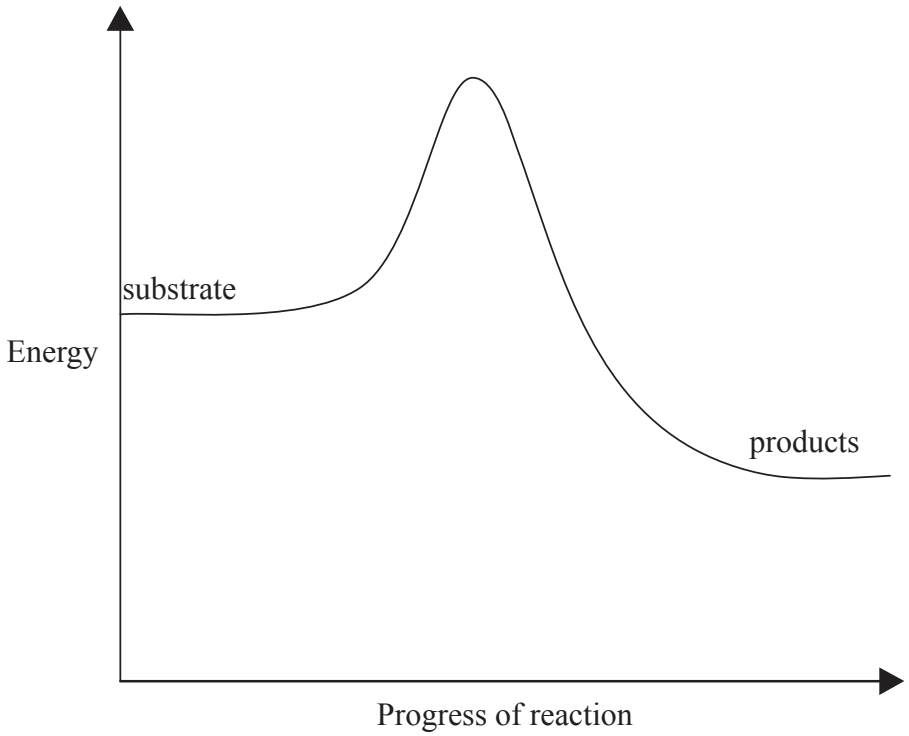
C2. The diagram below shows the energy change in an enzyme-controlled reaction before an enzyme is added.



(a) (i) Draw a line on the graph to show the progress of the reaction after addition of the enzyme. *[2]*

(ii) Deduce whether the reaction is **either** exergonic **or** endergonic. *[1]*

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(b) Explain the role of allosteric enzymes in metabolic pathways. *[3]*

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C3. (a) State the net gain of ATP molecules during glycolysis of one glucose molecule. *[1]*

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

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(c) Compare the process of chemiosmosis in both respiration and photosynthesis. *[3]*

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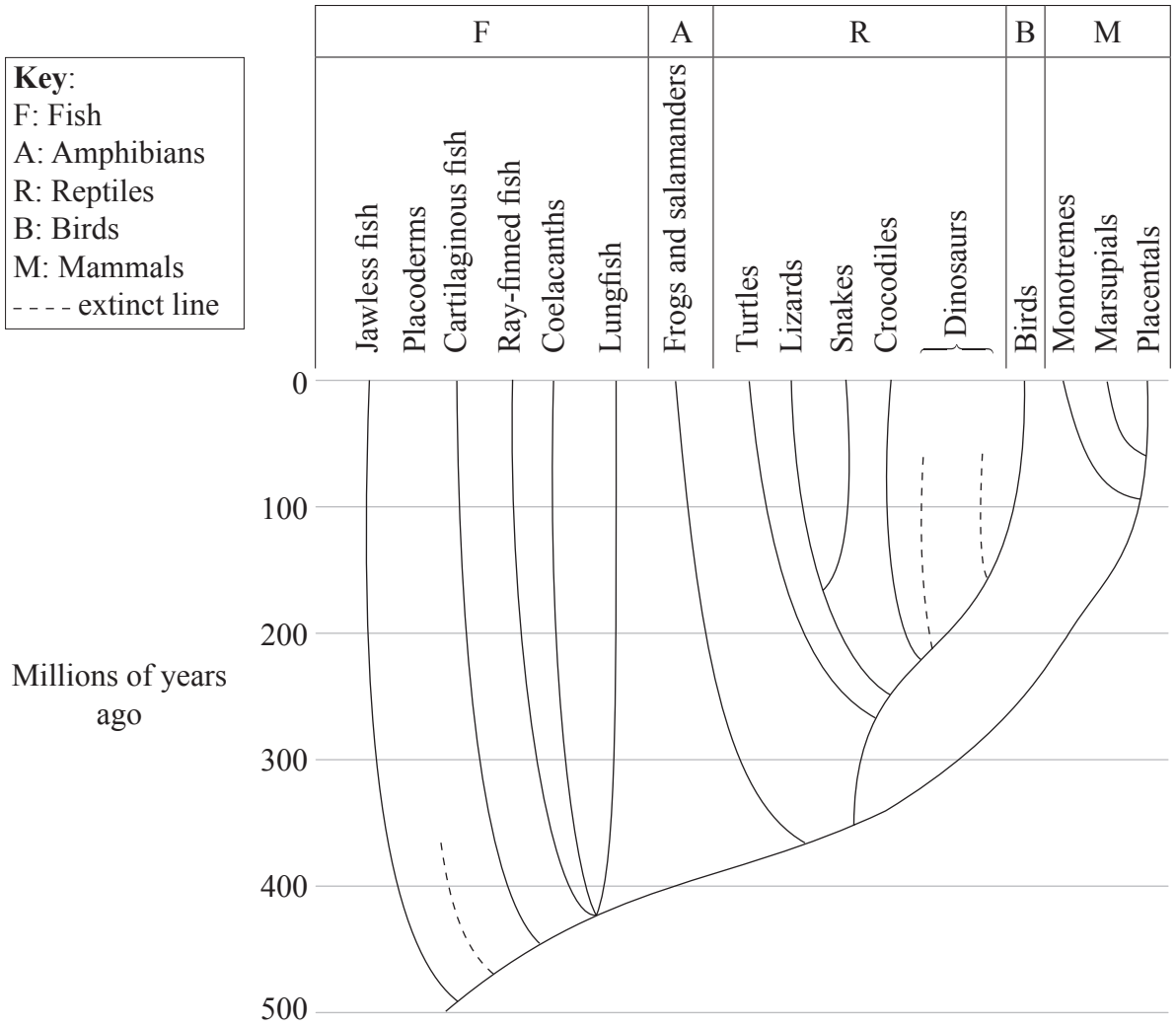
Option D — Evolution

D1. The phylogeny below shows how and when vertebrates could have evolved. The lines show when each lineage arose, split and in some cases became extinct.



[Source: http://evolution.Berkeley.edud/evosite/evo101/IIEAAddingtime.html
UC Museum of Paleontology's Understanding Evolution (http://evolution.berkeley.edu).]

(a) Identify how many years ago mammals split from birds and reptiles. *[1]*

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(b) State the evidence which allows scientists to know that Placoderms existed. *[1]*

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(This question continues on the following page)

(Question D1 continued)

(c) Birds and mammals are warm blooded. Discuss the hypothesis that some dinosaurs may have been warm blooded, using the phylogeny diagram opposite. *[3]*

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(d) Outline how the geographical distribution of mammals has affected their evolution. *[2]*

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D2. (a) Distinguish between Lamarck's theory of evolution and the theory put forward by Darwin and Wallace. *[2]*

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(b) Discuss whether special creation is supported by the scientific method. *[2]*

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(c) Outline how the development of bipedalism has contributed to human evolution. *[2]*

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D3. (a) State **two** conditions present in pre-biotic Earth which may have contributed to the origin of organic compounds. *[2]*

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(b) Discuss the evidence for the origins of eukaryotic cells. *[3]*

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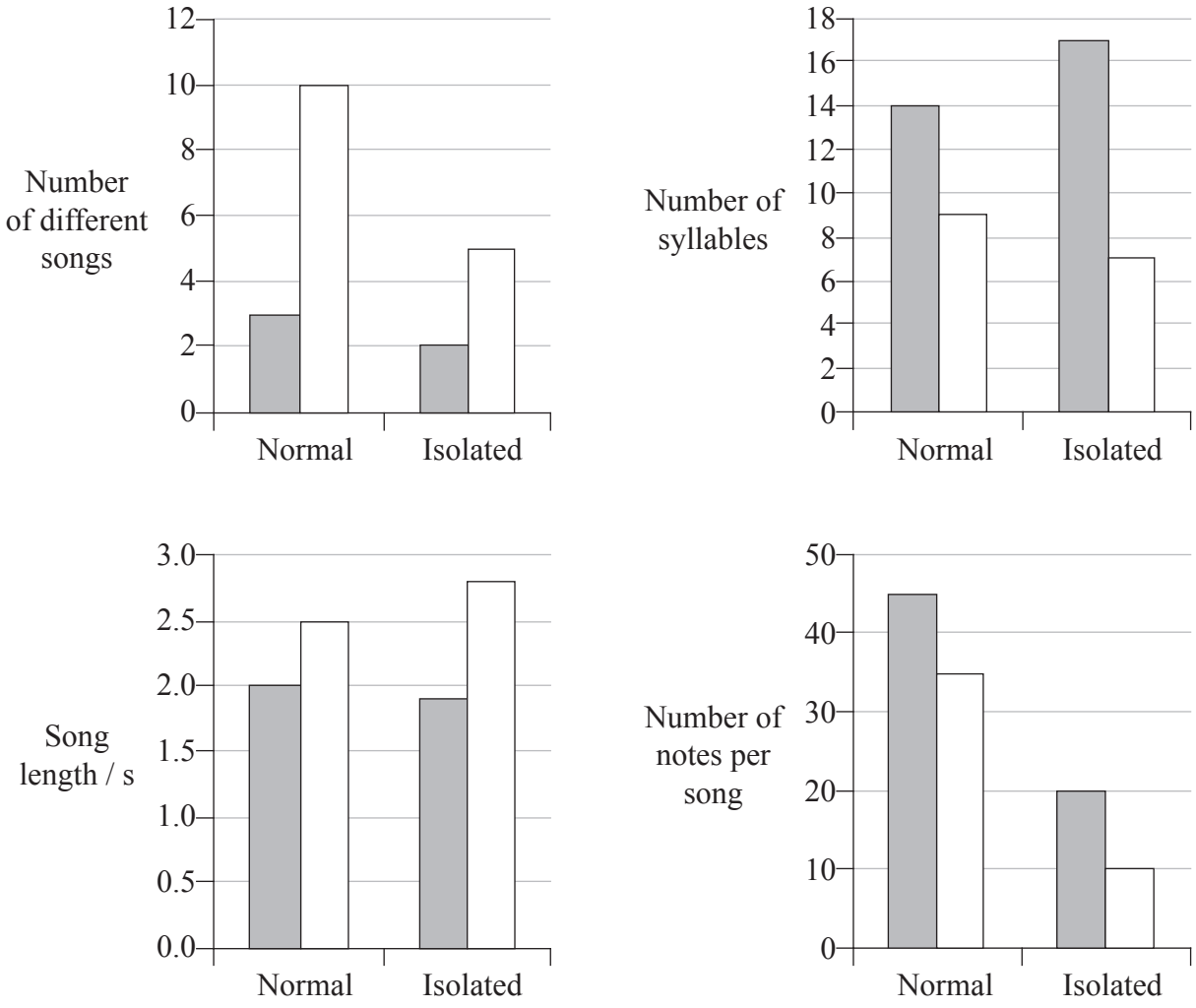
Option E — Neurobiology and Behaviour

E1. To determine whether bird song is innate or learned, songs of birds raised naturally were compared with the songs of those raised in isolation. Two species, the Swamp Sparrow *(Melospiza georgiana)* and the Song Sparrow *(Melospiza melodia)*, were studied. The number of different songs the birds sang, the average number of syllables in the notes, the average length of the songs and the total number of notes were recorded.



Key: ▭ Swamp Sparrow ▭ Song Sparrow

[Source: Peter Marler, *Anais da Academia Brasilereira de Ciências*, (2004), **76** (2), pages 189–200
Adapted from Peter Marler, An Acad Bra Cienc, (2004), 76 (2), pages 189-200]

(a) Calculate the difference in the number of notes per song between the normal and isolated Swamp Sparrows. *[1]*

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(This question continues on the following page)

(Question E1 continued)

(b) Compare the song length of both species of sparrow. *[2]*

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

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(d) Discuss whether the results for the Song Sparrow support the hypothesis that bird song is innate. *[3]*

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E2. (a) State a function of the

(i) hypothalamus. *[1]*

. . . . . .

(ii) cerebellum. *[1]*

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(b) Deduce, with a reason, the type of sensory receptor in the pupil reflex. *[2]*

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E3. (a) Outline an example of grooming in a species other than humans. *[2]*

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(b) Distinguish between taxis and kinesis. *[2]*

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(c) Discuss how learning may improve survival chances. *[3]*

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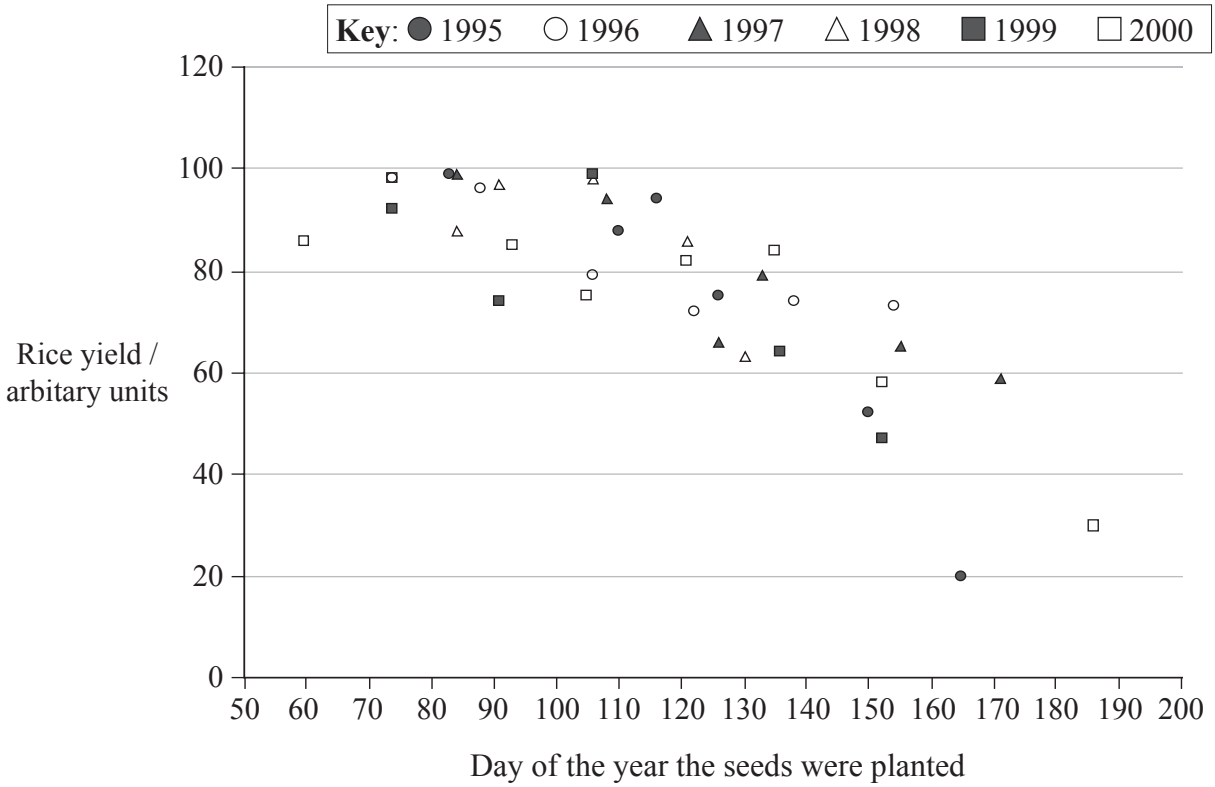
Option F — Applied Plant and Animal Science

F1. The scattergram below shows the results of a study carried out in Louisiana, USA, which compared the relationship between rice yield *(Oryza sativa)* and the day of the year the rice seeds were planted. Yields were measured over a six-year period between 1995 and 2000.



[Source: N Slaton *et al*., *Agronomy Journal*, (February 2003), **95**, pages 216–223]

(a) Identify the day of planting that gave the minimum rice yield in 2000. *[1]*

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(b) State the relationship between rice yield and day of planting. *[1]*

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(c) Compare the rice yields for 1995 and 2000. *[2]*

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(d) Suggest **one** explanation why the rice yield differed according to the day of the year the seeds were planted. *[2]*

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F2. (a) Define the term *net assimilation rate*. *[1]*

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(b) State **two** ways in which plant growth regulators can be used commercially. *[2]*

1. . . . . .

2. . . . . .

(c) Discuss the biological issues surrounding *organic* farming methods of plant cultivation. *[3]*

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F3. (a) State **one** animal species that has been domesticated. *[1]*

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(b) Outline **two** ethical issues arising from intensive animal rearing techniques. *[2]*

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(c) Explain how veterinary techniques have improved animal rearing programmes. *[3]*

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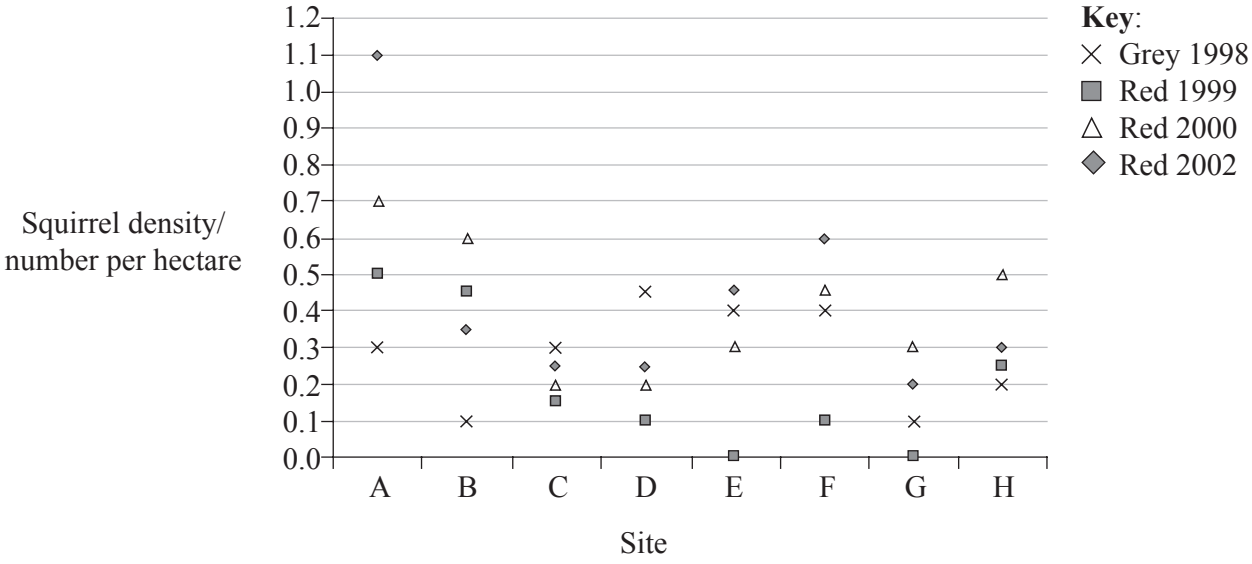
Option G — Ecology and Conservation

G1. Conservationists noticed that the number of red squirrels *(Sciurus vulgaris)* in Wales was declining, and the number of a newly introduced species, the North American grey squirrel *(Sciurus carolinensis)*, was increasing. In 1998, a project was started to reduce the number of grey squirrels in 244 hectares of woodland in Wales. The graph below shows the number of grey squirrels in 1998 and the number of red squirrels in 1999, 2000 and 2002. The data was collected at eight different sites (A-H).



[Source: Craig Shuttleworth, (2003), *Biologist*, **50**, (5), page 231, © **Institute of Biologists**]

(a) Identify the year in which the greatest number of red squirrels was found in site E. *[1]*

. . . . . .

(b) State the number of sites that had a greater density of red squirrels in 2002 compared with the density of grey squirrels in 1998. *[1]*

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(c) Discuss the hypothesis that decreasing the density of grey squirrels after 1999 led to an increase in the density of red squirrels in the following years. *[3]*

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(This question continues on the following page)

(Question G1 continued)

(d) Outline the relationship between grey squirrels and red squirrels assuming that they occupy the same niche. *[3]*

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G2. (a) A pine forest has a net production of $42\,kJ\,m^{-2}\,year^{-1}$. Respiration is $100\,kJ\,m^{-2}\,year^{-1}$. Calculate the gross production. *[1]*

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(b) State **two** difficulties of classifying organisms into trophic levels. *[2]*

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(c) Explain how living organisms may change the abiotic environment during ecological succession. *[3]*

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G3. (a) Outline **one** ecological and **one** economic reason for the conservation of biodiversity in a rain forest. *[2]*

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(b) Discuss the contribution of CITES to conservation. *[2]*

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