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

N07/4/BIOLO/SP3/ENG/TZ0/XX+

88076006

BIOLOGY
STANDARD LEVEL
PAPER 3

Monday 5 November 2007 (morning)

1 hour

Candidate session number

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INSTRUCTIONS TO CANDIDATES

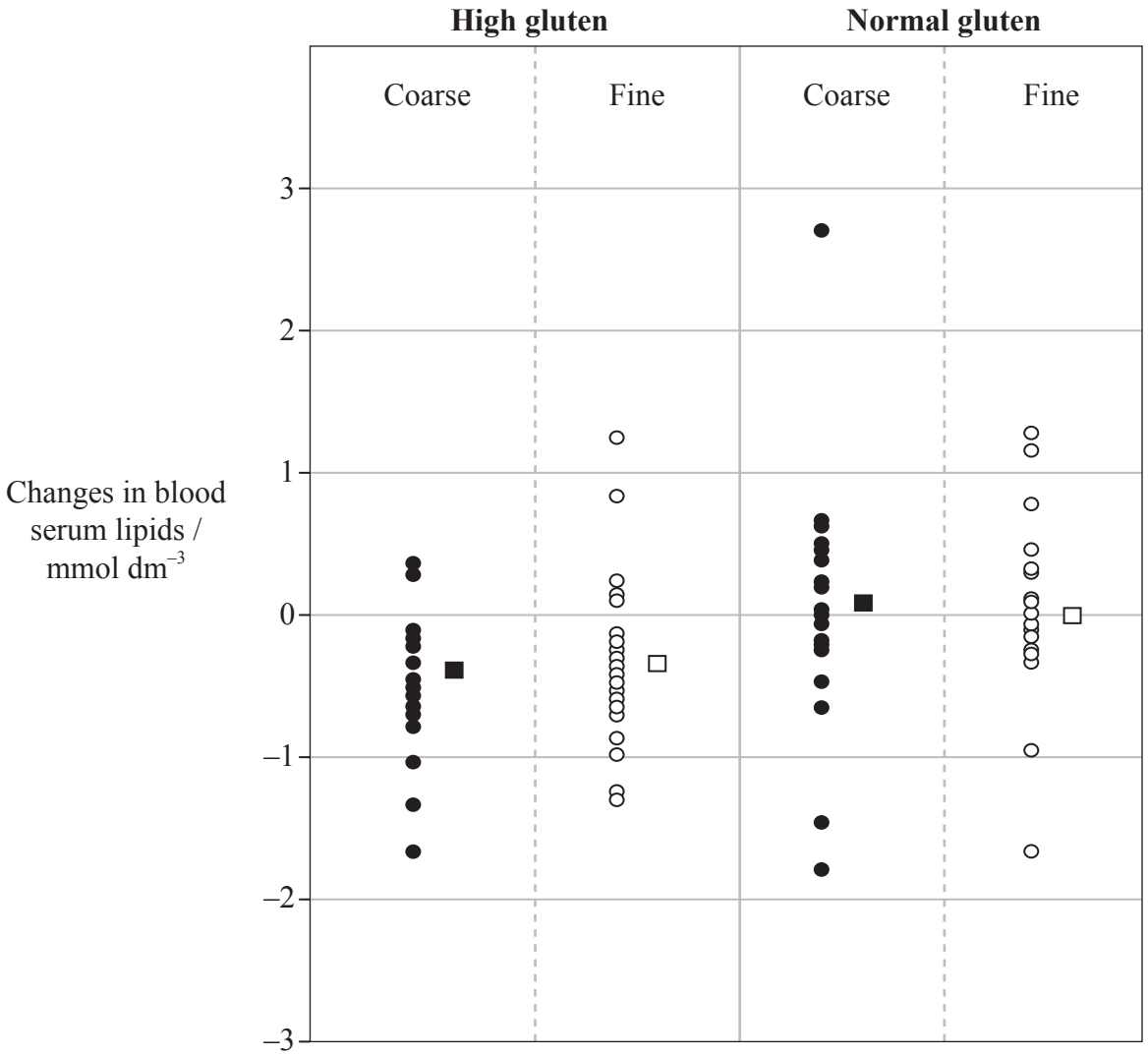
- Write your session number in the boxes above.
- Do not open this examination paper until instructed to do so.
- Answer all of the questions from two of the Options in the spaces provided. You may continue your answers on answer sheets. Write your session number on each answer sheet, and attach them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

0128

Option A — Diet and Human Nutrition

A1. Wheat flour in the diet can lower the quantity of lipids in the blood. A study was carried out to determine whether the size of flour particles (coarse or fine), or the amount of wheat protein gluten (high or normal) in wheat flour, contributed more to lowering the lipid level. Volunteers, in addition to their regular diets, were asked to eat bread made from different types of wheat flour over a period of several weeks. Measurements were made of the changes in the amounts of lipids in their blood serum.

The graph below shows the results for each volunteer (indicated by circles) and the mean values for each group (indicated by the squares).



[Source: David J A Jenkins *et al*., (1998), *Journal of the American College of Nutrition*, **18**, No 2, pages 159–165]

(This question continues on the following page)

(Question A1 continued)

(a) Identify the type of flour in the bread least effective in lowering blood serum lipid level. *[1]*

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(b) Compare the effects of the two types of bread made with fine flour on the lipids in the blood serum. *[2]*

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(c) Evaluate the hypothesis that the amount of the protein gluten in the flour is more important than the particle size in preventing cardiovascular disease. *[3]*

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(d) The fibre in the wheat flour may have contributed to lowering the blood serum lipid level. State **one** other function of fibre in the diet. *[1]*

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A2. (a) State **one** function of iodine in the diet. *[1]*

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(b) Outline the use of cholesterol in cell membranes. *[1]*

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(c) Discuss the risk of vegans developing rickets. *[3]*

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A3. (a) State **two** reasons why food additives are used. *[2]*

I. . . . . .

II. . . . . .

(b) Explain good hygiene techniques in preparing and handling foods. *[4]*

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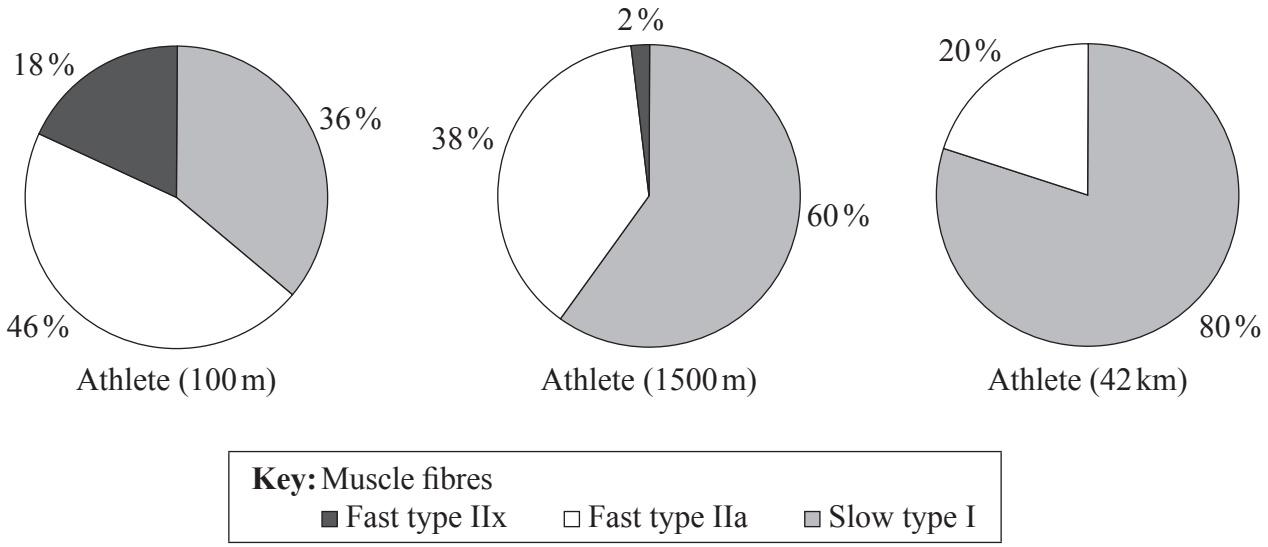
Option B — Physiology of Exercise

B1. The composition of skeletal muscle in the legs differs between individuals and can change according to the amount of training and exercise carried out. The pie-charts below show the differences in the types of muscle fibres found in three world-class athletes, each a specialist at a different distance.



[Source adapted from: Jesper L Andersen *et al*., (September 2000), *Scientific American*, pages 30–37]

(a) State the percentage of Fast type muscle fibres in the 1500 m athlete. *[1]*

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(b) Predict the percentage of Fast type IIa muscle fibre in a 10 km athlete. *[1]*

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(c) Compare the changes in muscle fibre composition between the athletes, as their running distance increases. *[2]*

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(This question continues on the following page)

(Question B1 continued)

(d) Explain how the muscle fibres of the 42 km athlete are adapted to their function. *[3]*

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B2. (a) State **one** hormone that increases the blood glucose level. *[1]*

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(b) Outline why heavy breathing continues after strenuous exercise is completed. *[2]*

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(c) Explain the effect of exercise on ventilation rate. *[4]*

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B3. (a) Distinguish between the functions of *ligaments* and *tendons*. *[1]*

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(b) Discuss the use of performance enhancing drugs in sport. *[3]*

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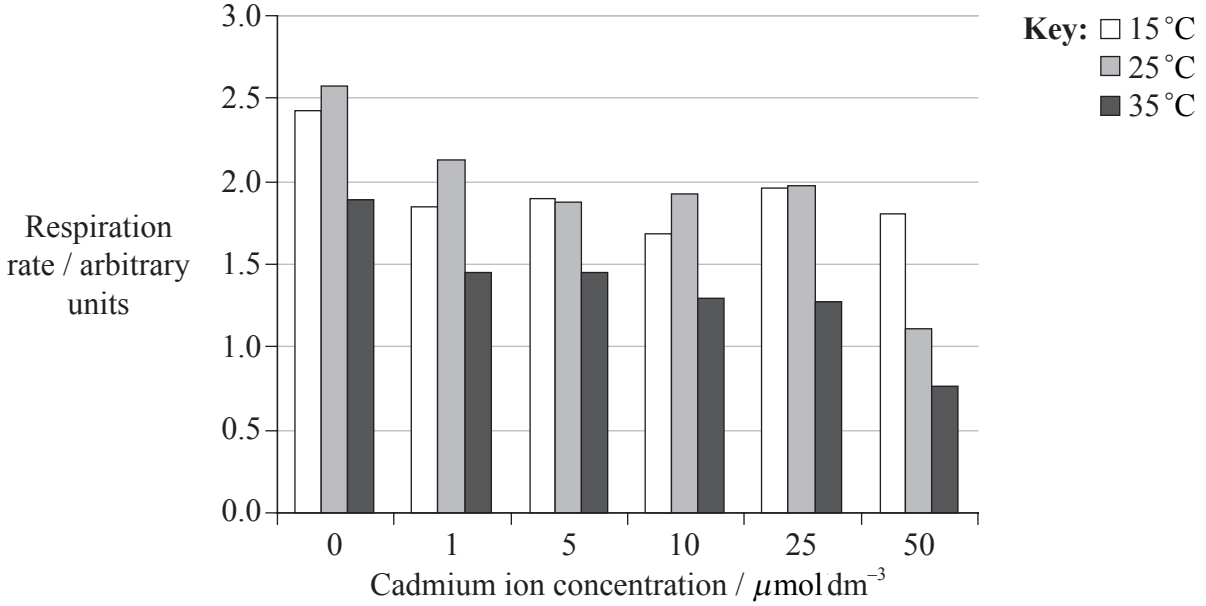
Option C — Cells and Energy

C1. The eastern oyster (*Crassostrea virginica*) is a marine mollusc that lives in estuaries. The environmental surroundings of the eastern oyster, such as the temperature and concentration of trace elements, are constantly changing. The trace element cadmium affects the mitochondria and prevents them from carrying out their function efficiently. Investigators isolated mitochondria from the oysters to study how the respiration rate changed while varying the water temperature and the cadmium ion concentration.



[Source: I M Sokolova, (2004), *The Journal of Experimental Biology*, **207**, pages 2639–2648. With permission of the Company of Biologists Ltd.]

(a) State the relationship between the concentration of cadmium ions and respiration rate at 35 °C. *[1]*

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(b) Compare the respiration rate of the mitochondria at cadmium ion concentrations of $0\,\mu mol\,dm^{-3}$ and $50\,\mu mol\,dm^{-3}$. *[2]*

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(This question continues on the following page)

(Question C1 continued)

(c) Suggest **one** other environmental property of the water, apart from temperature and mineral concentration, that may show daily changes. *[1]*

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(d) The investigators concluded that seasonal and global warming might make the eastern oysters more likely to suffer from trace element poisoning.

Using the data, evaluate this hypothesis. *[3]*

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C2. (a) State where in the chloroplast the enzymes of the Calvin cycle are located. *[1]*

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(b) Outline the fate of ribulose biphosphate (RuBP) during photosynthesis. *[2]*

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(c) A green plant is not photosynthesizing at its maximum rate when the light intensity is increased.

Suggest why there is no increase in the rate of photosynthesis. *[2]*

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C3. (a) State the function of a **named** protein. *[1]*

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(b) Outline the significance of the primary structure in a protein. *[2]*

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(c) Discuss the statement, "Enzyme inhibitors function by binding to the active site of the enzyme". *[3]*

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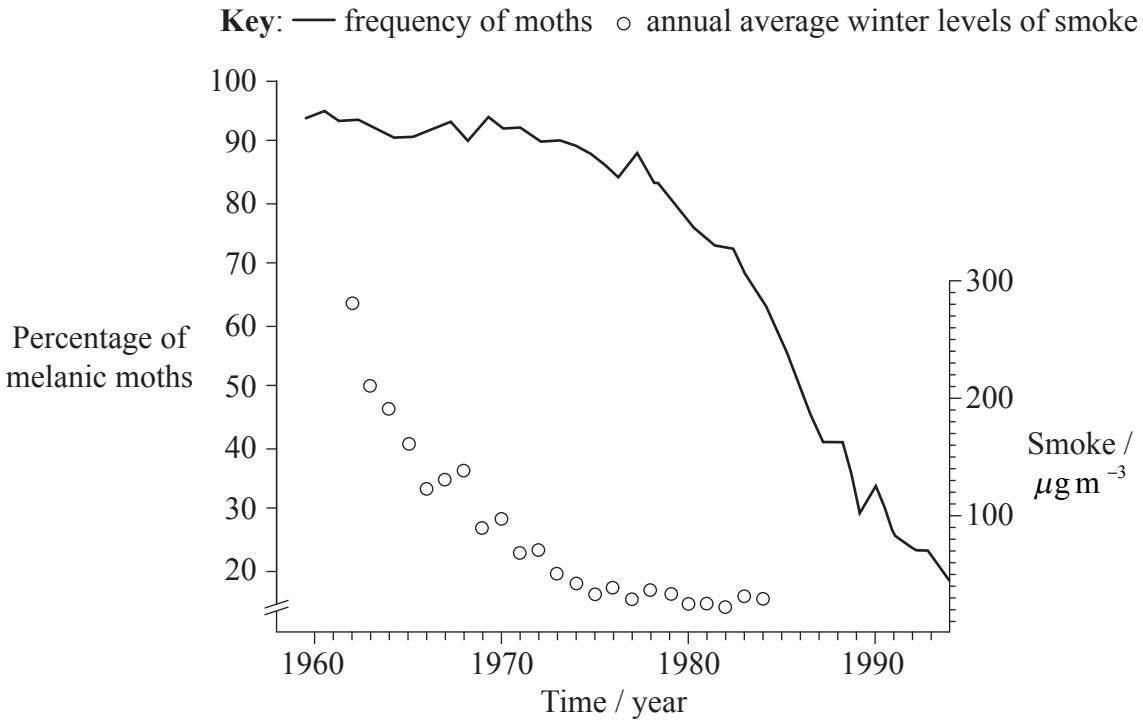
Option D — Evolution

D1. The peppered moth exists in two forms, the normal light coloured form and a dark melanic form. Studies were carried out in West Kirby, England to see if changes in the level of smoke pollution affected the frequency of the dark melanic moths. The graph below compares the percentage of moths that were melanic with the annual winter level of smoke.



[Source adapted from: Colin Patterson (1999), *Evolution*]

(a) State the level of smoke in 1969. *[1]*

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(b) Suggest a reason for the increase in smoke pollution from 1966 to 1968. *[1]*

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(This question continues on the following page)

(Question D1 continued)

(c) Compare the change in the percentage of melanic forms of moth with the changes in smoke in the air. *[2]*

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(d) Discuss whether the data shows evidence for evolution. *[3]*

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D2. (a) Define the term *homologous anatomical* structures. *[1]*

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(b) Outline how membranes may have originated in the first cells. *[2]*

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(c) Discuss how variations in a specific protein can be used as an evolutionary clock. *[3]*

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D3. (a) State **two** reasons why the fossil record may be incomplete. *[2]*

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II. . . . . .

(b) Discuss how ecological changes may have influenced the evolution of species of *Australopithecus*. *[3]*

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Option E — Neurobiology and Behaviour

E1. The cichlid (*Metriaclima zebra*) is a fish native to east Africa. Female cichlids show a hierarchal dominance where dominant cichlids chase and bite those below them in the hierarchy. In an experiment four female cichlids were placed together in a tank and the hierarchy between them was observed. They were ranked A, B, C or D, with A being the most dominant and D the least dominant. They were separated for two weeks and then returned to the tank to see if they maintained the same ranking. This was repeated with a total of twenty-two groups of female cichlids.

The table below shows dominance ranking, before and after separation. A total of twelve different results (I to XII) were obtained. The number in brackets is the number of groups in which that result was observed. Where no clear dominance was shown, the letters appear alongside each other.

I		II		III		IV	
Before	After	Before	After	Before	After	Before	After
A	A	A	B	A	A	A	A
B	B	B	A	B	B	B	C
C	C	C	C	C	D	C	B
D	D	D	D	D	C	D	D
(6)		(1)		(4)		(1)	
V		**VI**		**VII**		**VIII**	
Before	After	Before	After	Before	After	Before	After
A	D	A	A	A	C	A	B
B	B	–	C_1	B	A	B	C
C	C	$C_1C_2C_3$	C_2	C	B	C	A
D	A	–	C_3	D	D	D	D
(1)		(1)		(1)		(2)	
IX		**X**		**XI**		**XII**	
Before	After	Before	After	Before	After	Before	After
A	B	A	C	A	D	A	C_1
B	–	B	A	B	A	–	C_2
C	ACD	C	D	C	B	$C_1C_2C_3$	A
D	–	D	B	D	C	–	C_3
(1)		(2)		(1)		(1)	

[Source: *Proceedings of the National Academy of Sciences*, vol. 99, issue 8, April 16 2002, "Individual differences versus social dynamics in the formation of animal dominance hierarchies", Ivan D. Chase, Craig Tovey, Debra Spangler-Martin and Michael Manfredonia, pp. 5744-49, Fig.1. Copyright 2002, National Academy of Sciences, USA]

(a) State in how many groups the most dominant female cichlid was replaced after the separation. *[1]*

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(This question continues on the following page)

(Question E1 continued)

(b) Calculate the percentage of female cichlids ranked D in their group that did not change ranking after the separation. *[1]*

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(c) Compare the results in I with VI. *[3]*

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(d) Suggest the evolutionary advantage to female cichlids in having a hierarchal dominance pattern. *[2]*

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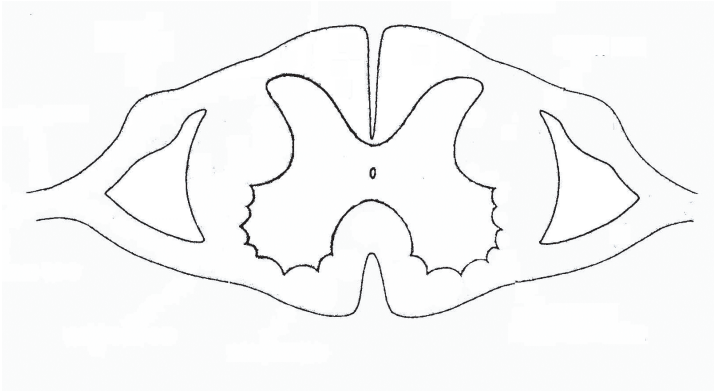
E2. (a) The diagram below shows a transverse section through the spinal cord. Draw and label the components of a reflex arc on the diagram. *[2]*



(b) State **one** function of the hypothalamus. *[1]*

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(c) Outline what is meant by a mechanoreceptor using a **named** example. *[2]*

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

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(b) Describe how honey bees show social organization. *[2]*

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(c) Explain, with reference to **one** example, the role of altruistic behaviour in social organizations. *[3]*

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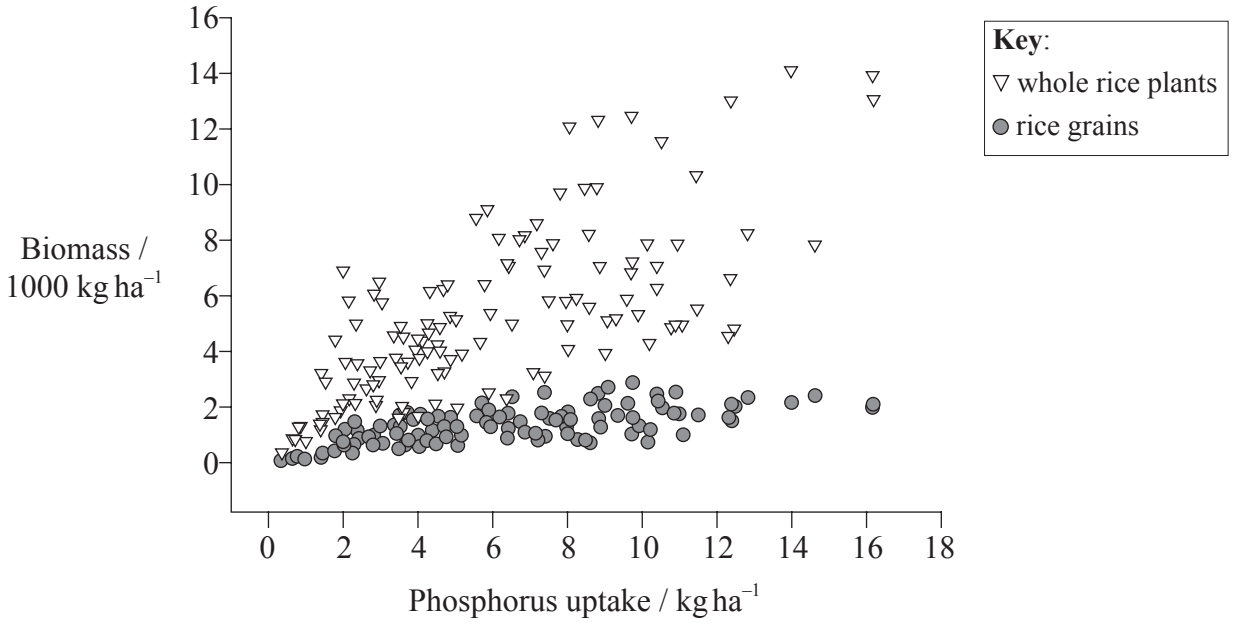
Option F — Applied Plant and Animal Science

F1. In parts of Asia, phosphorus deficiency in the soil is thought to be the reason for poor rice yields. In Laos, Thailand and the Philippines researchers cultivated rice with varying quantities of phosphorus fertilizer. When the crops were ready for harvesting the phosphorus uptake of the plants was measured. This was compared to both the dry biomass of rice grains and of the whole rice plants.



[Source: Thomas George *et al*., (2001), *Agron*, pages 1352–1370]

(a) State the biomass of the whole rice plants when the phosphorus uptake was 14 kg ha^{-1}. *[1]*

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(b) State the relationship between phosphorus uptake and the biomass of the whole rice plants. *[1]*

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(c) Define the term *harvestable dry biomass*. *[1]*

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(This question continues on the following page)

(Question F1 continued)

(d) Discuss, with reference to both the graph and your knowledge of plant cultivation, whether Asian farmers should be advised to purchase phosphorus fertilizers to increase crop yield. *[3]*

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F2. (a) Distinguish between *inbreeding* and *outbreeding*. *[1]*

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(b) Outline, by using a **named** example, how animal breeding techniques have improved food yield. *[2]*

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(c) Discuss the issues surrounding the use of chemicals to control pests. *[3]*

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F3. (a) State the method of crop production without the use of soil. *[1]*

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

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(c) Explain phototropism in shoots as an example of the control of plant growth. *[3]*

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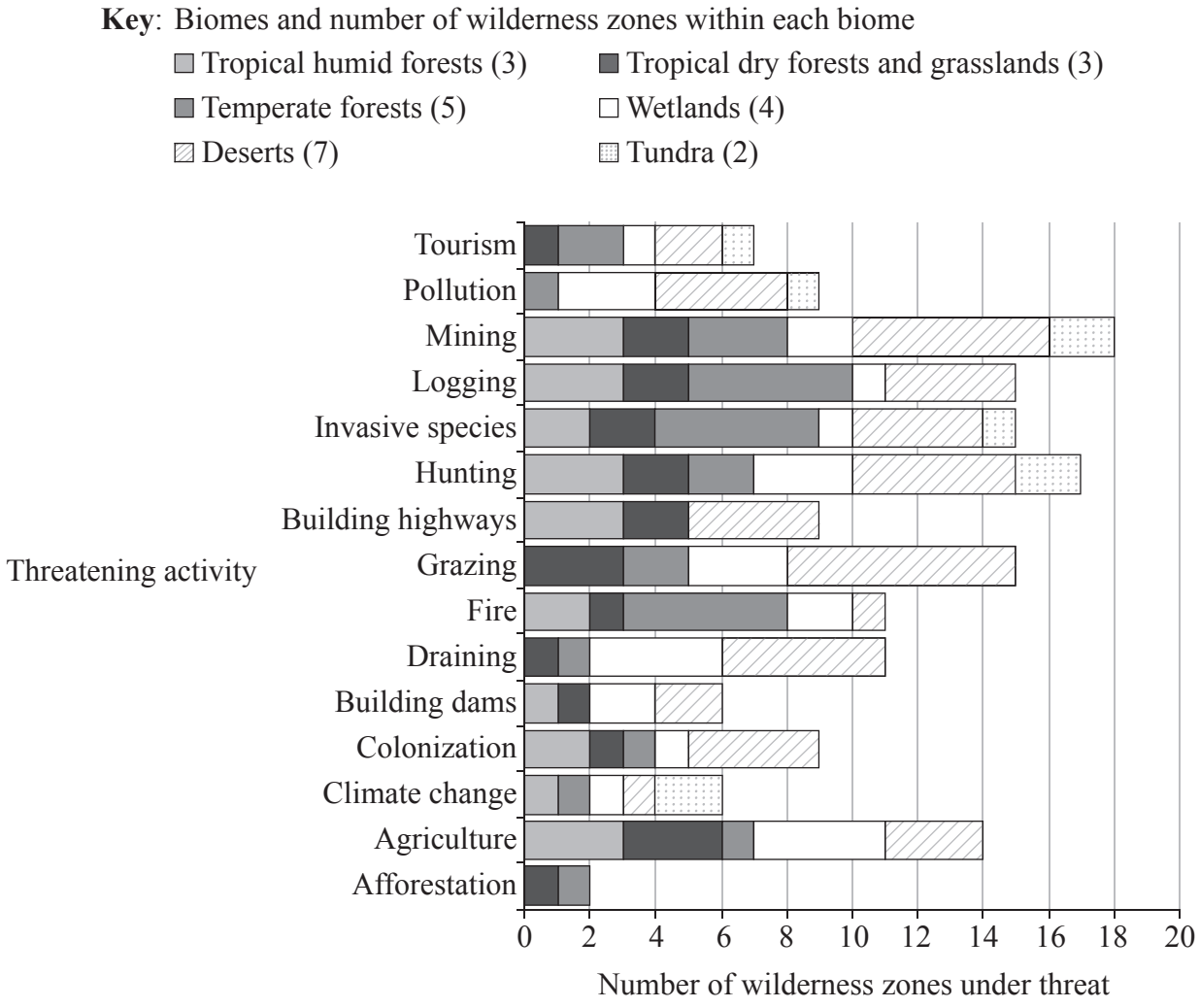
Option G — Ecology and Conservation

G1. Conservationists identified twenty-four wilderness zones in the world. A wilderness is defined as an area greater than 10 000 km^2, with a human population of less than five inhabitants per km^2 and is mostly unspoiled, therefore, retaining its natural condition. Various activities threaten the biodiversity of these wilderness zones. Each wilderness zone was identified as belonging to one of six major biomes. The chart below shows the number of wilderness zones belonging to each biome and the number under threat.



[Source: *Proceedings of the National Academy of Sciences*, vol. 100, issue 18, September 2 2003, "Wilderness and biodiversity conservation", R. A. Mittermeier, C. G. Mittermeier, T. M. Brooks, J. D. Pilgrim, W. R. Konstant, G. A. B. da Fonseca and C. Kormos, pp. 10309-13, Fig.2. Copyright 2003, National Academy of Sciences, USA]

(a) State how many of the activities threaten all of the biomes. *[1]*

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(This question continues on the following page)

(Question G1 continued)

(b) Identify **one** activity that threatens **all** desert wilderness zones. *[1]*

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(c) Compare the effects of pollution and climate change on the biomes. *[3]*

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(d) Suggest how fire affects biodiversity. *[1]*

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G2. (a) State the unit that would be used for each bar in a pyramid of energy. *[1]*

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(b) Distinguish between *predation* and *parasitism*. *[2]*

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(c) Discuss the difficulties when classifying organisms into trophic levels. *[3]*

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G3. (a) Define the term *in situ* conservation. *[1]*

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(b) Outline the factors that led to the extinction of a **named** animal species in the last 1000 years. *[2]*

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(c) Explain how biotic indices can be used to monitor environmental change. *[3]*

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