INTERNATIONAL BACCALAUREATE
BACCALAURÉAT INTERNATIONAL
BACHILLERATO INTERNACIONAL

N01/410/S(3)

BIOLOGY
STANDARD LEVEL
PAPER 3

Tuesday 6 November 2001 (morning)

1 hour 15 minutes

Name

Number

INSTRUCTIONS TO CANDIDATES

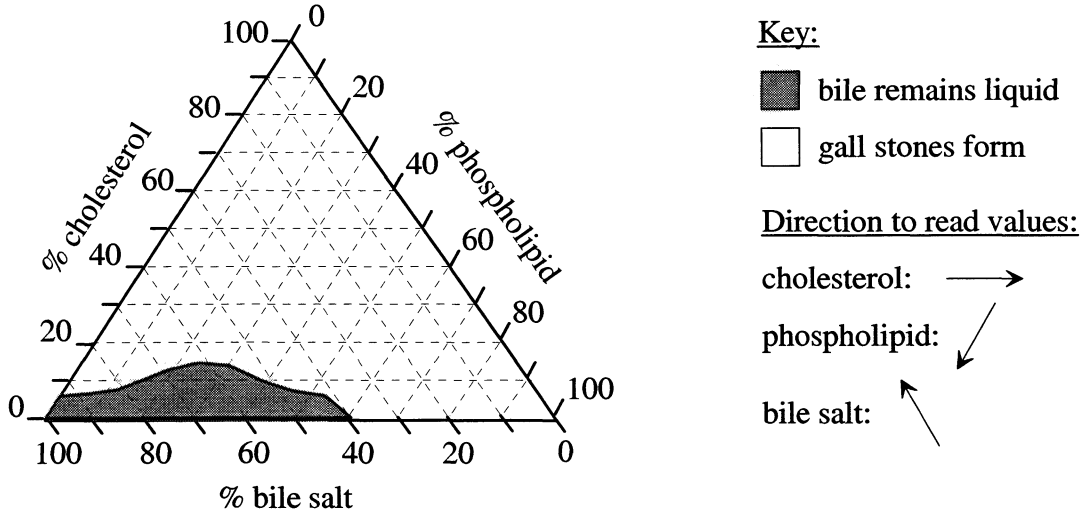
- Write your candidate name and number in the boxes above.
- Do not open this examination paper until instructed to do so.
- Answer all of the questions from three of the Options in the spaces provided. You may continue your answers in a continuation answer booklet, and indicate the number of booklets used in the box below. Write your name and candidate number on the front cover of the continuation answer booklets, and attach them to this question paper using the tag provided.
- At the end of the examination, indicate the letters of the Options answered in the boxes below.

OPTIONS ANSWERED		EXAMINER	TEAM LEADER	IBCA
		/15	/15	/15
		/15	/15	/15
		/15	/15	/15
NUMBER OF CONTINUATION BOOKLETS USED	. . . . .	TOTAL /45	TOTAL /45	TOTAL /45

Option A – Diet and human nutrition

A1. Bile is a fluid secreted by the liver and stored in the gall bladder. It is released into the intestine to help in the digestion of fatty foods. Bile has a very variable composition. Its three major components in addition to water are cholesterol, phospholipid and bile salts. When the relative amounts of these major components stay within certain limits the bile remains liquid. Outside these limits, solid lumps called gall stones can form in the gall bladder. Gall stones, which consist mainly of crystallised cholesterol, can prevent the release of bile from the gall bladder.

The graph below shows the percentages of cholesterol, phospholipid and bile salt at which bile remains liquid and the percentages at which gall stones tend to form.



(Source: Small, 1969, *New England Journal of Medicine*, **279**, pages 588-93)

(a) (i) State the maximum percentage of cholesterol that can be present in bile without gall stones forming. *[1]*

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(ii) State the minimum percentage of phospholipid that would be needed to prevent gall stone formation, if the percentage of bile salt was 50 %. *[1]*

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(b) (i) Using only the data in the graph, deduce the relationship between the amount of bile salt in the bile and whether gall stones form or not. *[1]*

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(ii) Suggest a reason for the effect of bile salts on gall stone formation. *[1]*

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(This question continues on the following page)

(Question A1 continued)

(c) (i) One of the factors which causes gall stones is fasting or missing meals. Suggest how this could be associated with gall stone formation. *[1]*

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(ii) Suggest **one** other factor, related to diet, for gall stone formation. *[1]*

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A2. (a) (i) State **two** examples of foods containing large amounts of sugar. *[1]*

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(ii) State **two** examples of foods containing large amounts of polysaccharide. *[1]*

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(b) Outline the ways in which carbohydrates absorbed from food are used in the human body. *[3]*

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A3. (a) State, in qualitative terms, how much energy there should be in a balanced diet. *[1]*

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(b) Discuss the differences in energy requirements between males and females. *[3]*

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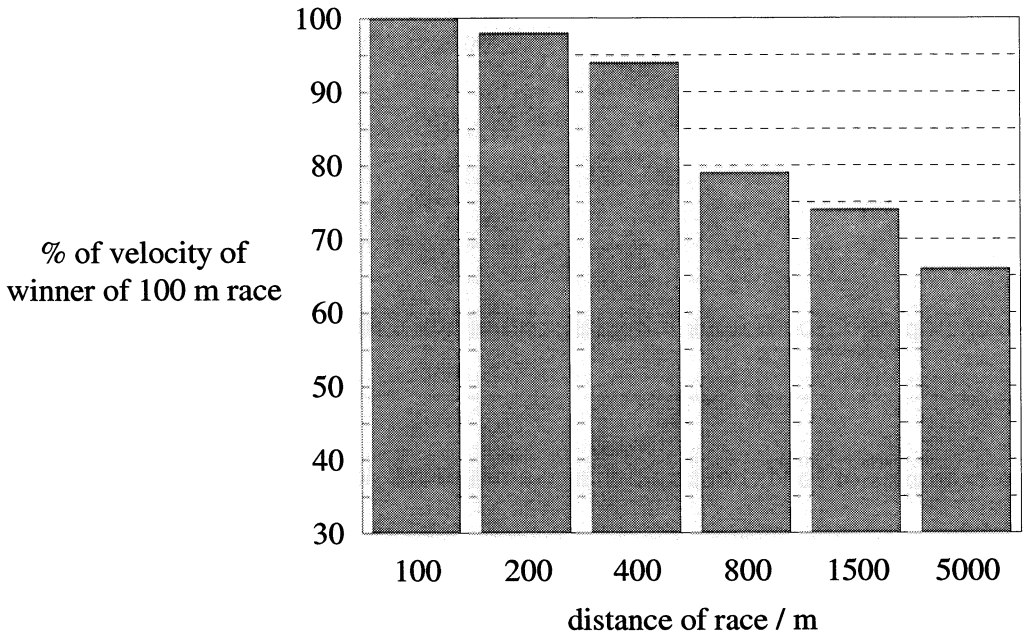
Option B – Physiology of exercise

B1. The World Athletics Championships were held in Seville in August 1999. The bar chart below shows a comparison of the velocity of the athletes who won the mens' sprint and middle distance races. The winner of the 100 m race ran at a velocity of 9.80 metres per second. The mean velocity of the athletes who won the other races is shown as a percentage of the velocity of the winner of the 100 m race.



(a) (i) Using only the data in the chart, outline the relationship between the distance of the race and the velocity of the winner. *[1]*

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(ii) Suggest **two** reasons for this relationship. *[2]*

1 . . . . . .

. . . . . .

2 . . . . . .

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(b) The winner of the 400 m race set a new world record. State how modern athletes are able to run faster than their predecessors. *[1]*

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(This question continues on the following page)

(Question B1 continued)

(c) (i) Each increase in distance is associated with a change in velocity. State which increase in distance is associated with the largest change in velocity. *[1]*

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(ii) Suggest reasons for this increase in distance having a greater effect on mean velocity than the other increases. *[2]*

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B2. (a) Explain briefly how skeletal muscle contracts. *[3]*

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(b) Outline the effect of adrenaline on the activity of muscles. *[2]*

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B3. (a) State which type of neurone stimulates skeletal muscles to contract. *[1]*

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(b) Outline how this type of neurone passes a stimulus to the muscle. *[2]*

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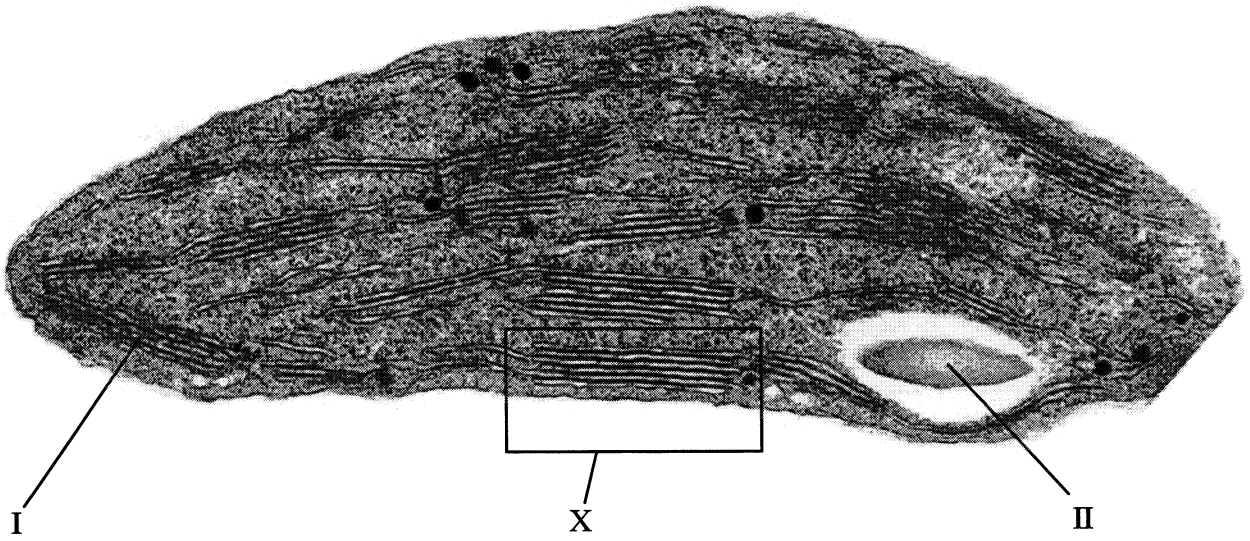
Option C – Cells and energy

C1. The electron micrograph shows a chloroplast from *Avena sativa*.



(Source: George McCartney)

(a) State the names of the structures labelled I and II. *[1]*

I ..... II .....

(b) (i) Redraw the part of the chloroplast marked X in the box below to show the details of its structure. *[2]*

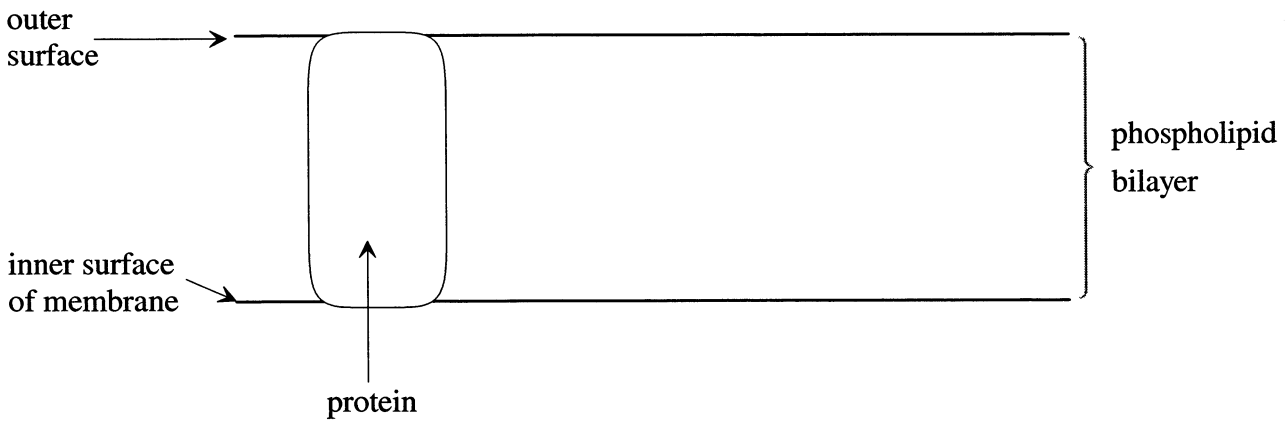
(ii) Annotate your drawing to show the regions into which hydrogen ions are pumped during chemiosmosis. *[1]*

(c) Annotate the electron micrograph to show

(i) a region where the light independent reactions take place; *[1]*

(ii) a location of chlorophyll. *[1]*

C2.



(a) The diagram above shows the position of a protein in a membrane. Predict where, on the surface of this protein, polar amino acids would be found and where non-polar amino acids would be found. *[2]*

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(b) Draw **two** more proteins onto the diagram to show other positions that membrane proteins can occupy. *[2]*

C3. (a) (i) State **one** product of the Krebs cycle which is usually excreted. *[1]*

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(ii) State **two** products of the Krebs cycle which are useful to the cell. *[2]*

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(b) Explain briefly why the Krebs cycle cannot continue if electron transport stops in a mitochondrion. *[2]*

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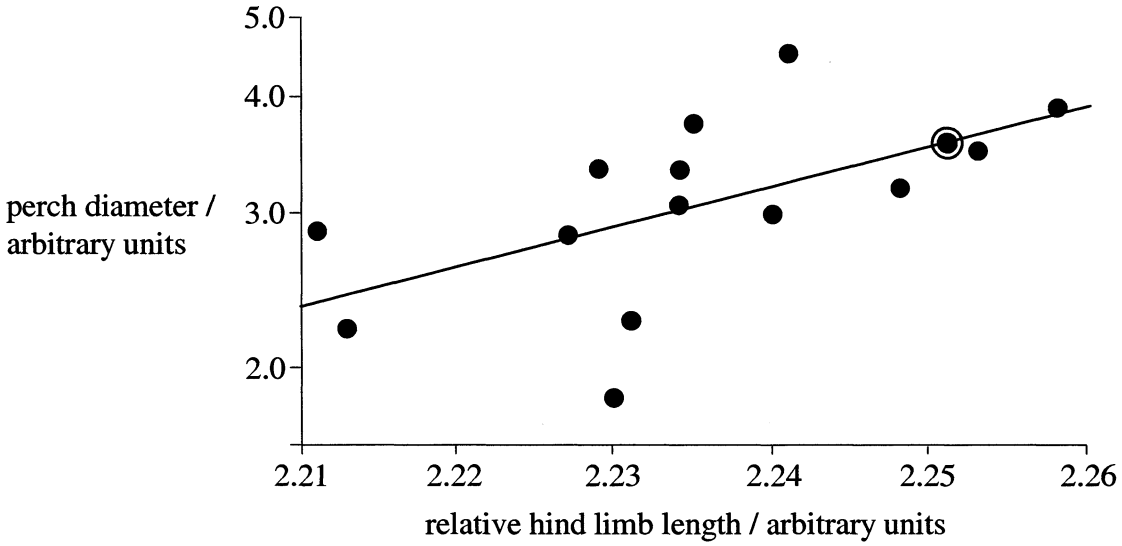
Option D – Evolution

D1. The process of evolution has been investigated using *Anolis sagrei*, a species of lizard found in the Bahamas. Males and females were collected from one island and then small numbers of them were released onto 14 other islands, which did not already contain the lizards. A random procedure was used to ensure that the populations released onto each island were similar. The islands on which the lizards were released all had different vegetation from the island from which they were removed. After 14 years, samples of lizards were obtained from all of the islands and measurements were taken. These included the length of the hind limb and the diameter of the tree branch on which the lizard was sitting (the perch).
The scattergraph below shows mean relative hind limb length and the mean perch diameter for lizards from each island. The circled point is for the island from which the lizards were originally taken.



(Source: Losos *et al*, 1997, *Nature*, **387**, pages 70-73)

(a) State the relationship shown in the graph between relative hind limb length and perch diameter. *[1]*

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(b) Annotate the graph to show

(i) the point for the island on which the perch diameter was most different from that of the original island; *[1]*

(ii) the point for the island on which the rate of evolution of hind limb length was greatest. *[1]*

(c) Suggest **one** environmental factor which may have caused the change in hind limb length. *[1]*

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(This question continues on the following page)

(Question D1 continued)

(d) How would Lamarck's theory of inheritance of acquired characteristics explain how the lizards' hind limb length could have changed? *[3]*

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D2. (a) Outline **one** process of fossil formation. *[3]*

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(b) Outline **one** use of radioisotopes in the study of fossils. *[2]*

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D3. Identify, with a reason, whether genetic or cultural evolution is responsible for the development of: *[3]*

(a) language .....

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(b) large brain size .....

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(c) religion .....

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Option E – Neurobiology and behaviour

E1. Oystercatchers (*Haematopus ostralegus*) are birds that live and feed on seashores. In the spring males and females establish territories and breed. Both male and female oystercatchers help to incubate the eggs in the nest by sitting on them. Occasionally instead of a pair of oystercatchers, three are found in a territory, one male and two females. This is called polygyny. Polygynous groups were studied on the island of Schiermonnikoog in the Netherlands. Two behaviour patterns were found: co-operative and aggressive polygyny. In co-operative polygyny the two females defend the territory together, groom each other and lay their eggs together in the same nest. In aggressive polygyny the two females defend the territory together against other birds, but show aggressive behaviour towards each other and lay their eggs in separate nests.

The table below shows some of the results for the three behaviour patterns observed.

Behaviour pattern	**% of the time that the eggs are incubated by a female**	**% of the time that the eggs are incubated by the male**	**Mean number of eggs per nest**	**% hatching success of the eggs**	**Mean number of eggs hatched per female**
pair (male and female)	51.2	43.3	2.5	43.0	1.08
co-operative polygyny	80.2	19.8	4.6	23.0	0.53
aggressive polygyny	22.8	54.3	1.6	25.8	0.41

(Source: Heg and Treuren, 1998, *Nature*, **391**, pages 687-691)

(a) Suggest **one** reason for the difference in incubation time between

(i) a female bird in a pair and female birds in a co-operative polygynous group; *[1]*

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(ii) a female bird in a pair and a female bird in an aggressive polygynous group; *[1]*

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(iii) a male bird in a pair and a male bird in a co-operative polygynous group. *[1]*

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(This question continues on the following page)

(Question E1 continued)

(b) Evaluate the three behaviour patterns in terms of successful reproduction. *[3]*

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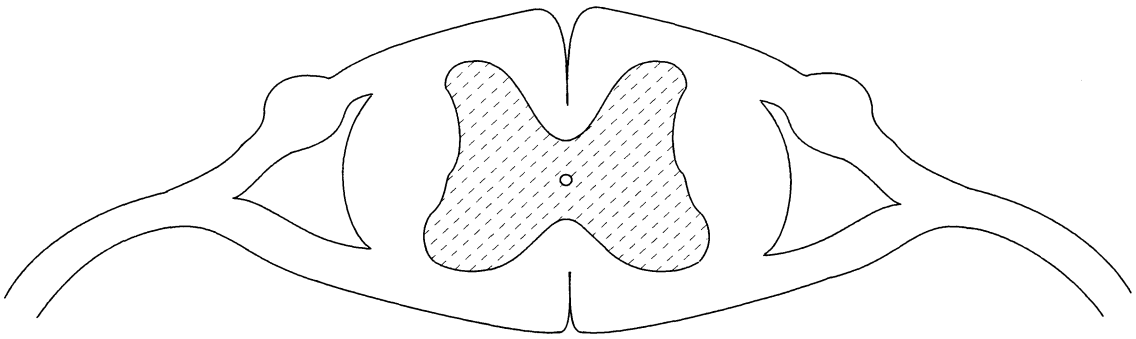
E2. (a) Human spinal reflexes involve neural pathways known as *reflex arcs*. Part of each reflex arc is located in the spinal cord and associated spinal nerves. Draw the neurones which form this part of a spinal reflex arc using the outline diagram below. *[3]*



(b) State **two** examples of human spinal reflexes. *[2]*

1 .....

2 .....

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

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(b) Outline Konrad Lorenz's experiments on imprinting in geese. *[3]*

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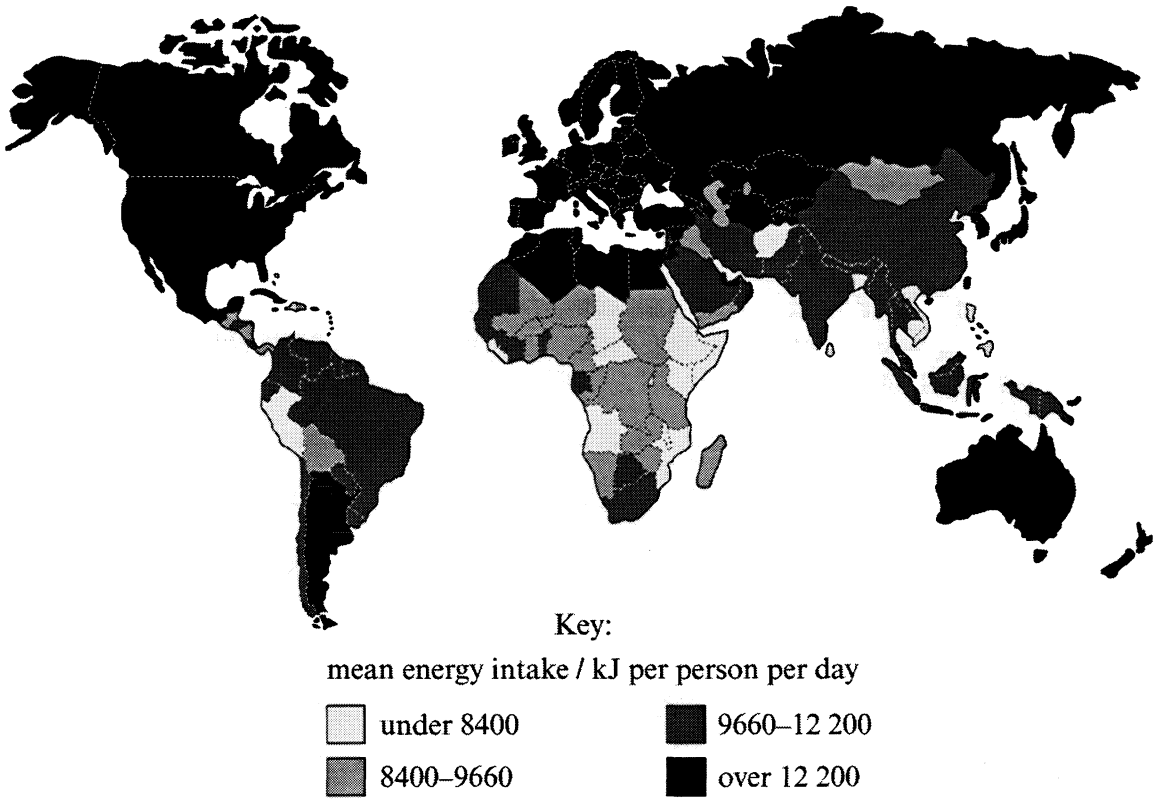
Option F – Applied plant and animal science

F1. The map below shows the mean dietary energy intake of people throughout the world. The minimum daily energy intake is considered to be 9250 kJ.



(Source: United Nations Food and Agriculture Organisation)

(a) Using only the information on the map, outline the overall trend that can be seen in energy intake at different latitudes. *[2]*

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(b) (i) State the mean energy intake in **one** developing country shown on the map. *[1]*

developing country ..... mean energy intake .....

(ii) Suggest **two** factors which have an important effect on the mean energy intake in this developing country. *[2]*

1 .....

2 .....

(This question continues on the following page)

(Question F1 continued)

(c) All of the developed countries shown on the map have a high mean energy intake. Discuss whether these countries are net importers or exporters of food. *[2]*

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F2. Describe a technique for improving houseplants by

(a) tissue culture; *[2]*

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(b) pruning off shoot tips. *[2]*

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F3. Evaluate intensive farming techniques in terms of

(a) yield; *[2]*

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(b) ethical issues. *[2]*

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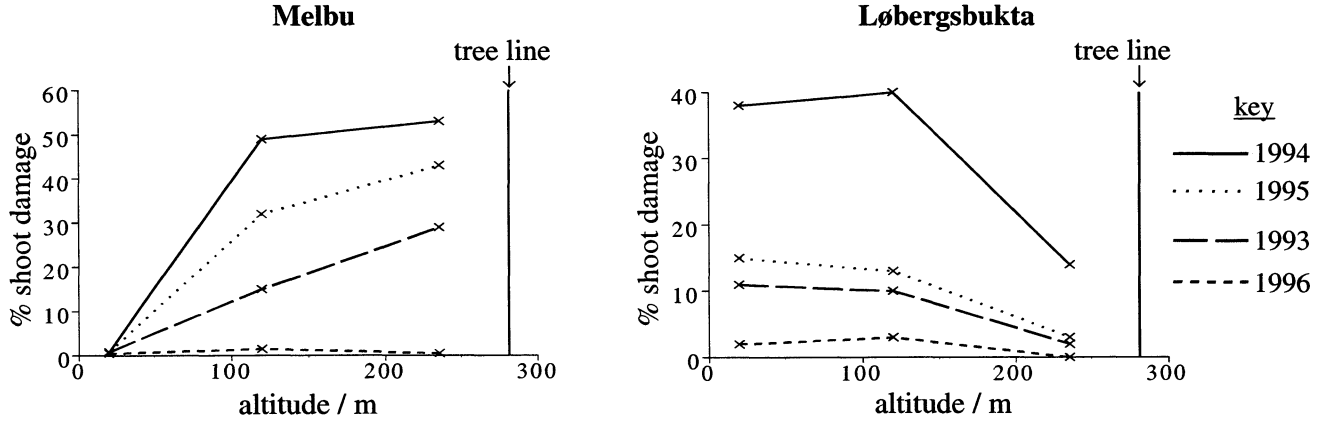
Option G – Ecology and conservation

G1. In the early 1980s scientists noticed for the first time that forests of birch trees (*Betula pubescens*) in north-west Norway had been damaged by larvae of an insect, *Argyresthia retinella*. For several years the population of *A. retinella* was very large. Shoots and sometimes whole birch trees were killed. The scientists measured the damage at different altitudes in many forests. The results for two forests are shown below. Melbu is on the coast and Løbergsbukta is inland. The tree line is the highest altitude at which trees will grow.



(Source: Tenow *et al*, 1999, *Journal of Applied Ecology*, **36**, pages 111-122)

(a) (i) Outline the relationship between altitude and percentage damage to shoots at Melbu and Løbergsbukta in 1993. *[2]*

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(ii) Suggest **one** reason for the effect of altitude either at Melbu or at Løbergsbukta. *[1]*

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(b) Deduce from the data in the graphs how the population of *A. retinella* changed between 1993 and 1996. *[2]*

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(c) Populations of insects such as *A. retinella* which rise to high levels usually subsequently fall. Suggest **one** reason for these falls. *[1]*

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(This question continues on the following page)

(Question G1 continued)

(d) Severe attacks due to population explosions of *A. retinella* had not been recorded before the 1990s. Suggest **one** reason they might only have begun in the 1990s. *[1]*

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G2. Explain briefly how during a primary succession from bare rock

(a) gross production changes; *[1]*

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(b) the water cycle changes; *[2]*

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(c) soil erosion is reduced. *[1]*

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G3. (a) State what can be measured using the Simpson formula. *[1]*

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(b) Outline the use of

(i) indicator species in monitoring environmental change; *[2]*

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(ii) environmental impact assessment. *[1]*

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