INTERNATIONAL BACCALAUREATE
BACCALAURÉAT INTERNATIONAL
BACHILLERATO INTERNACIONAL

N01/410/H(3)

BIOLOGY
HIGHER 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 two 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
		/20	/20	/20
		/20	/20	/20
NUMBER OF CONTINUATION BOOKLETS USED	. . . . .	TOTAL /40	TOTAL /40	TOTAL /40

Option D – Evolution

D1. *Petrogale lateralis* is an Australian marsupial, commonly known as the black-footed rock-wallaby. Evidence suggests that about 30 000 years ago it spread to an island, 55 km away from the mainland. Since then the island and the mainland populations have remained isolated from each other. Conservationists recently investigated the populations. They measured the male : female ratio and the percentage of females that had reproduced and were carrying offspring. They also took blood samples from rock-wallabies in both populations. Tests on these samples allowed the genotype of each of the rock-wallabies to be deduced for 14 different genes. If more than one allele of a gene is present in a population, the population is **polymorphic** for that gene. If only one allele is present, the population is **non-polymorphic**. The results of the investigations are shown in the following table.

	Island population	**Mainland population**
Male : female ratio	1 : 2.5	1 : 1.5
Percentage of females carrying offspring	52	89
Polymorphic genes	1 of the 14 genes is polymorphic	10 of the 14 genes are polymorphic

(Source: Eldridge, MD, *et al*, *Conservation Biology*, **13** (3), pages 531-538, 1999)

(a) Suggest **one** reason for the difference in the percentage of females carrying offspring in the two populations. *[1]*

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(b) (i) Identify, with a reason, which population has a higher percentage of rock-wallabies that are heterozygous for the 14 genes. *[1]*

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(ii) Predict, with reasons, which population would be more vulnerable to extinction if there was a period of rapid environmental change. *[2]*

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(This question continues on the following page)

(Question D1 continued)

(c) Discuss briefly whether the island population of rock-wallabies has been in Hardy Weinberg equilibrium over the last 30 000 years. *[2]*

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D2. (a) State the full classification of human beings. *[2]*

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(b) State the advantages to primates of *[2]*

(i) opposable thumbs;

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(ii) forward facing eyes.

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D3. (a) Discuss the possible role of RNA in the origin of life on earth. *[4]*

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(b) Describe the different types of evidence for evolution. *[6]*

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Option E – Neurobiology and behaviour

E1. (a) Describe the roles of different members of a colony of honey bees. *[6]*

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(b) Suggest why there should be restrictions on the sale and consumption of alcoholic drinks. *[4]*

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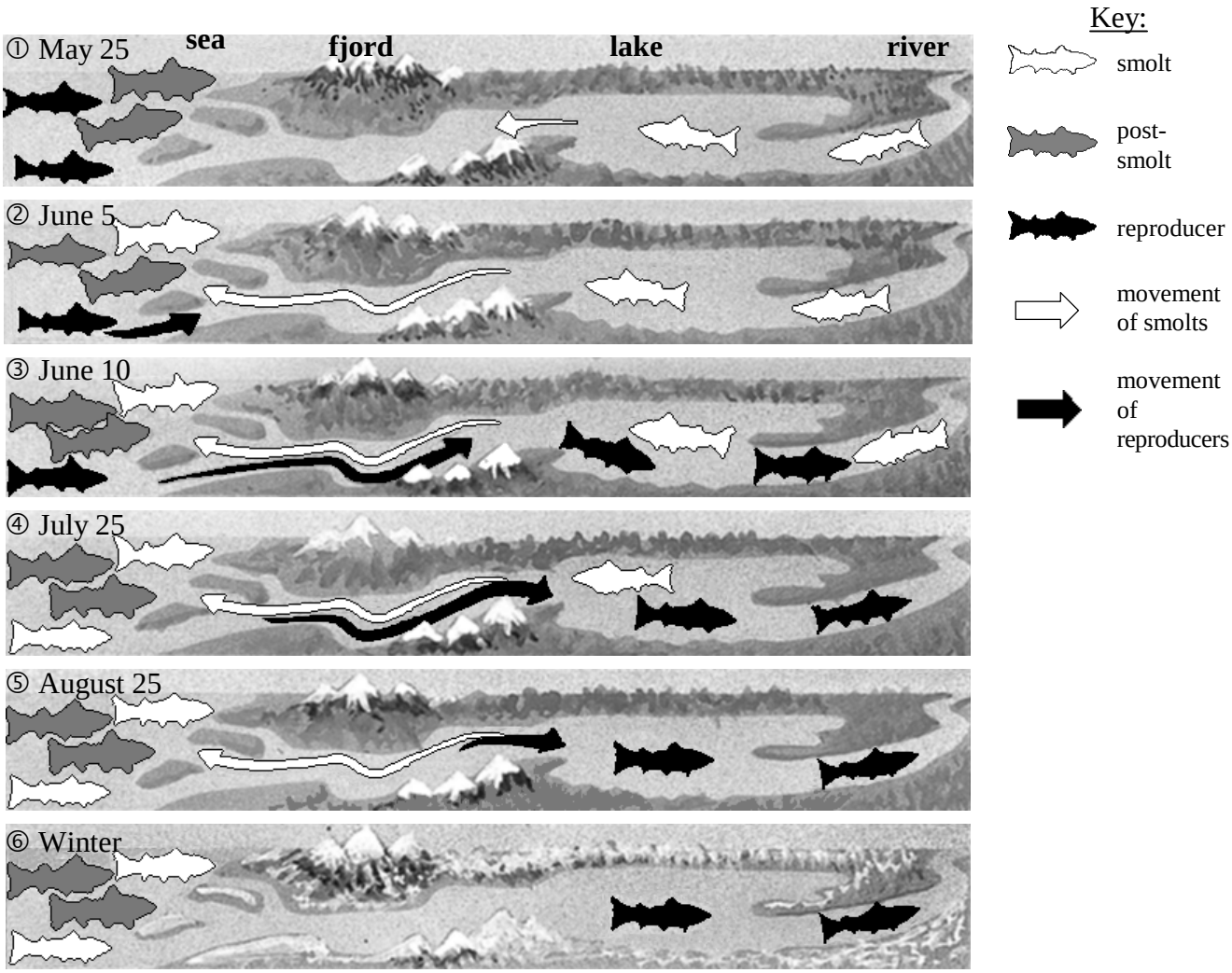
E2. Scientists studied the movement of migratory trout, *Salmo trutta*, in Norway. The timing of the movements of fish of three different ages - the young (smolts), the immature (post-smolts) and the mature (reproducers) - are shown in the diagram below.



(Saglio, P, *La Recherche*, **13**(131), pages 42–55, 1993.)

(This question continues on the following page)

(Question E2 continued)

(a) Outline the movements of the fish from May to winter. *[2]*

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(b) Predict the events that occur in the life cycle of *Salmo trutta* from winter to May. *[2]*

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(c) One widely supported hypothesis is that mature fish migrate upstream to the river in response to a chemical released by the migrating smolts. Design an experiment to test this hypothesis. *[2]*

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E3. (a) State **one** example of kinesis in a specific organism. *[1]*

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(b) (i) State **one** example of taxis in a specific organism. *[1]*

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(ii) Explain the importance of this response to the survival of the species. *[2]*

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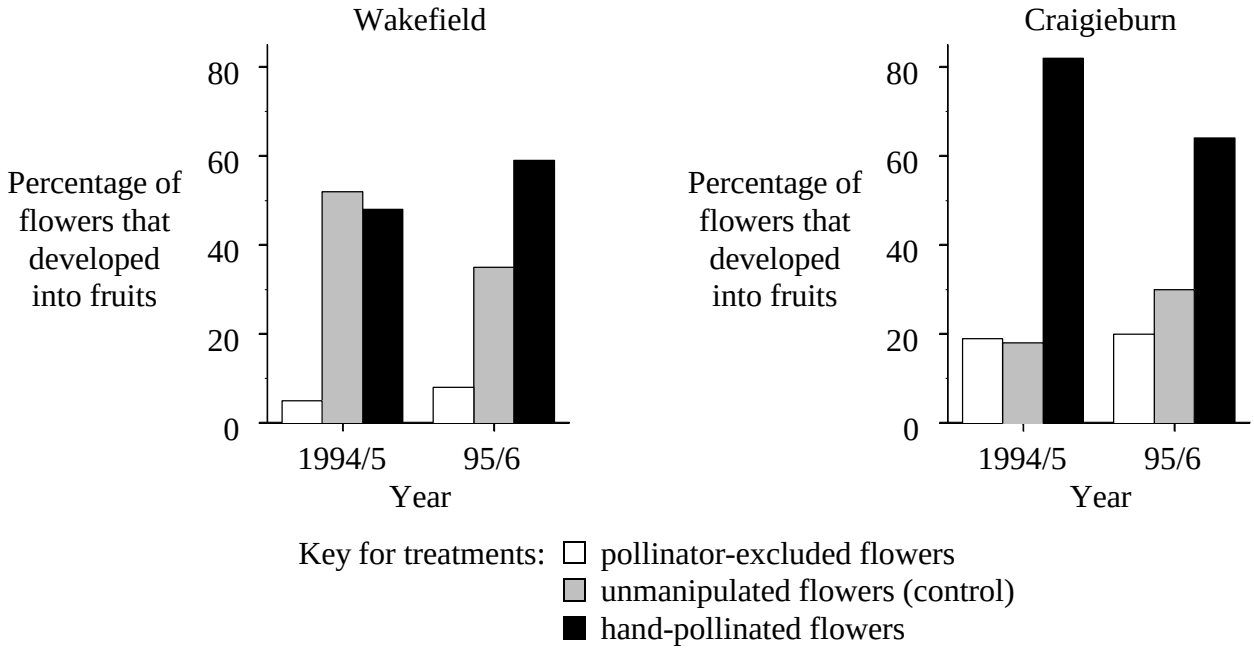
Option F – Applied plant and animal science

F1. Scientists recently investigated the pollination by birds of a native plant in New Zealand. The plant, *Peraxilla*, produces large numbers of flowers, but many of these fail to develop into fruits. Experiments were performed at two sites where *Peraxilla* grows, Wakefield and Craigieburn. Some flowers were covered to exclude the bird pollinators. Other flowers were hand-pollinated. A third group of flowers was left unmanipulated to act as controls. The results for the summers of 1994 to 1995 and 1995 to 1996 are shown in the bar charts below.



(Source: Robertson, A W *et al*, *Conservation Biology*, 1999, **13** (3), pages 499–508)

(a) Compare the results for the control flowers at Wakefield with those at Craigieburn. *[2]*

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(b) The scientists were testing a hypothesis that the low percentages of flowers developing into fruits was due to low numbers of the bird pollinators.

Evaluate this hypothesis using the data in the bar charts. *[3]*

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(This question continues on the following page)

(Question F1 continued)

(c) Suggest **one** other hypothesis to account for the low percentages of flowers developing into fruits at Wakefield **or** Craigieburn. *[1]*

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F2. (a) Describe the function of pruning in the production of bushy plants. *[2]*

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(b) Outline the use of a plant growth substance (plant hormone) to promote rooting of cuttings. *[2]*

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F3. (a) Explain how different veterinary techniques can improve the health and fecundity of animals. *[6]*

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(b) Outline biological and ethical issues in the use of animal organs for transplants into humans. *[4]*

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Option G – Ecology and conservation

G1. (a) Outline reasons for differences in gross production in different ecosystems. *[4]*

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(b) Evaluate **three** renewable energy sources in terms of their advantages and disadvantages. *[6]*

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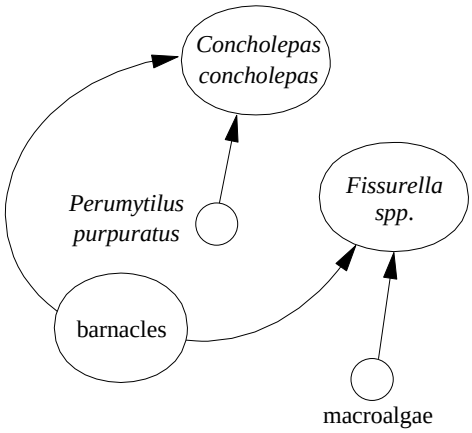
G2. In Chile a study was carried out to investigate the ecological role of humans in an intertidal marine community. A marine reserve was used as the human exclusion area and an adjacent area served as the human impact site. Four mollusc populations and one producer population were studied in both areas:

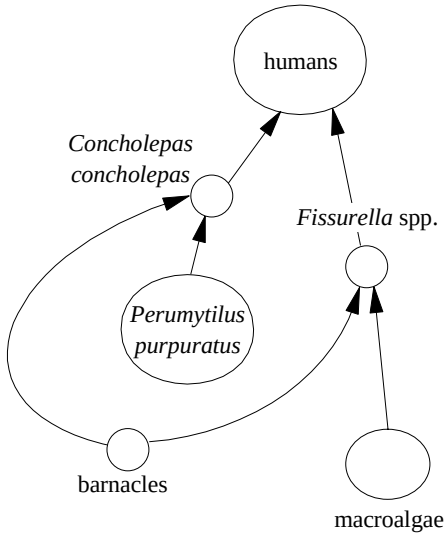
1. *Concholepas concholepas*: a carnivorous gastropod;
2. *Perumytilus purpuratus*: a small filter-feeding mussel;
3. *Fisurella spp.*: omnivorous keyhole limpets;
4. two species of filter-feeding barnacles;
5. macroalgae.

The results are shown in the diagram below. The size of the circles is proportional to the density of each species. The arrows represent food relationships.

Human exclusion area



Human impact area



(Source: Castilla, J C, *Trends in Ecology and Evolution*, **14** (7), pages 280–283, 1999)

(a) Identify the effects of humans on the population densities of *[2]*

(i) *Concholepas concholepas* and *Fisurella spp.*;

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(ii) *Perumytilus purpuratus* and macroalgae.

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(This question continues on the following page)

(Question G2 continued)

(b) Suggest **one** reason for the low density of the barnacles in the human impact area. *[2]*

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(c) Deduce **two** effects of humans on the pyramid of energy for the marine community. *[2]*

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G3. (a) (i) State the group to which all chemoautotrophs belong. *[1]*

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(ii) Outline how chemoautotrophs obtain energy. *[1]*

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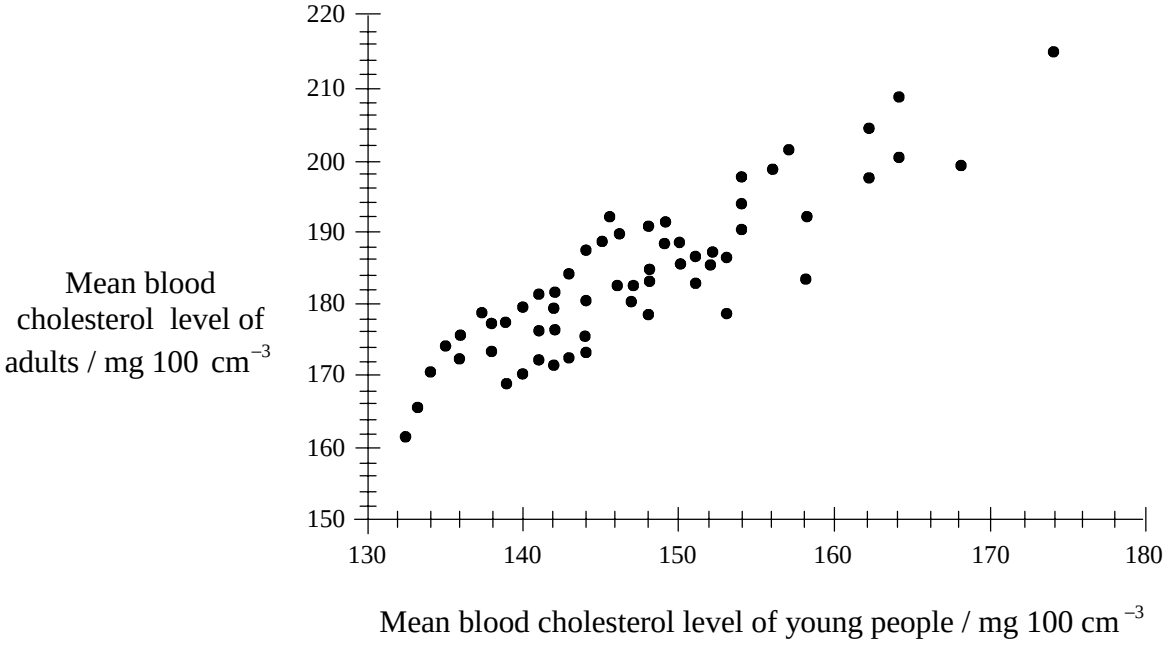
(b) List **one** substance that acts as an electron donor and **one** substance that acts as an electron receiver in chemoautotrophs. *[2]*

Donor: . . . . . .

Receiver: . . . . . .

Option H – Further human physiology

H1. In 1998 the blood cholesterol level of 70 000 people in Mexico was measured. The people were divided into two age groups: 1 to 19 years (young people) and 20 to 98 years (adults). Mean blood cholesterol levels were calculated for the two age groups in each of the different states of Mexico. Each point on the graph shows the mean blood cholesterol level for the two age groups in one state.



(Source: Posada-Romero *et al*, *Salud Pública de México*, **34** (2), pages 157-167, 1992)

(a) (i) State the relationship between cholesterol levels in young people and adults. *[1]*

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(ii) Predict, using the data in the graph, how the blood cholesterol level usually changes over a lifetime. *[2]*

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(b) The maximum desirable blood cholesterol level is 200 mg 100 cm^{-3} of blood. Suggest the implications of the survey of blood cholesterol levels for the population of Mexico. *[3]*

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H2. (a) (i) State the main problem with gas exchange at high altitudes. *[1]*

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(ii) State **one** symptom that may appear due to this problem. *[1]*

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(b) Compare the adaptations to high altitude of an indigenous person with the short-term adaptations that develop in a traveller to high altitude. *[2]*

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H3. (a) Outline the formation of tissue fluid and lymph in body tissues. *[4]*

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(b) Explain how the structures of a secretory cell in an exocrine gland are related to their functions. *[6]*

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