INTERNATIONAL BACCALAUREATE
BACCALAURÉAT INTERNATIONAL
BACHILLERATO INTERNACIONAL

M00/410/H(2)

BIOLOGY
HIGHER LEVEL
PAPER 2

Thursday 11 May 2000 (afternoon)

2 hours 15 minutes

Name

Number

INSTRUCTIONS TO CANDIDATES

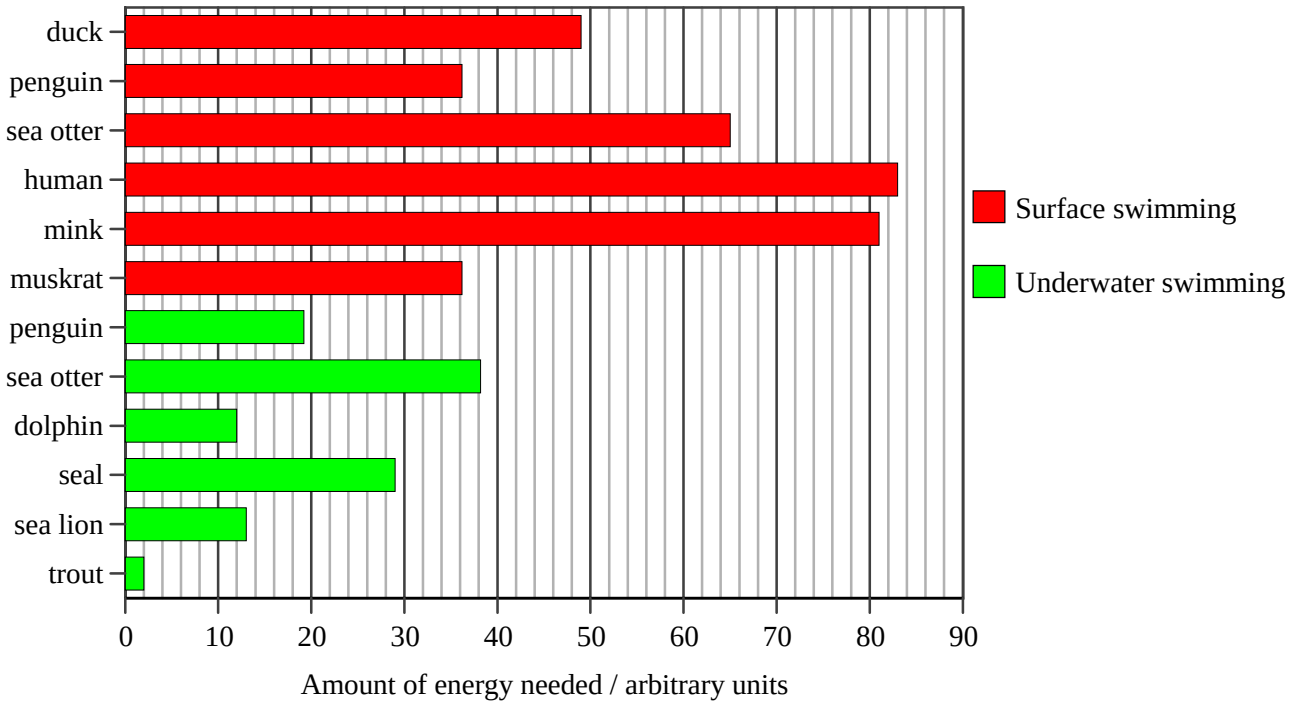
- Write your candidate name and number in the boxes above.
- Do not open this examination paper until instructed to do so.
- Section A: Answer all of Section A in the spaces provided.
- Section B: Answer two questions from Section B. You may use the lined pages at the end of this paper or continue your 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 numbers of the Section B questions answered in the boxes below.

QUESTIONS ANSWERED		EXAMINER	TEAM LEADER	IBCA
SECTION A	ALL	/32	/32	/32
SECTION B				
QUESTION	. . . . .	/20	/20	/20
QUESTION	. . . . .	/20	/20	/20
NUMBER OF CONTINUATION BOOKLETS USED	. . . . .	TOTAL /72	TOTAL /72	TOTAL /72

SECTION A

*Candidates must answer **all** questions in the spaces provided.*

1. Animals move using many different methods. The chart below shows how much energy is needed by animals to swim on the surface of water and underwater. The chart shows the relative amount of energy that is needed to move an equal mass of each animal over an equal distance.



(Source: Alexander, *Nature*, (1999) **397** pages 651-653)

(a) By reference to named animals, compare underwater swimming with surface swimming. *[2]*

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(b) Suggest **two** reasons for the high energy cost of swimming in humans. *[2]*

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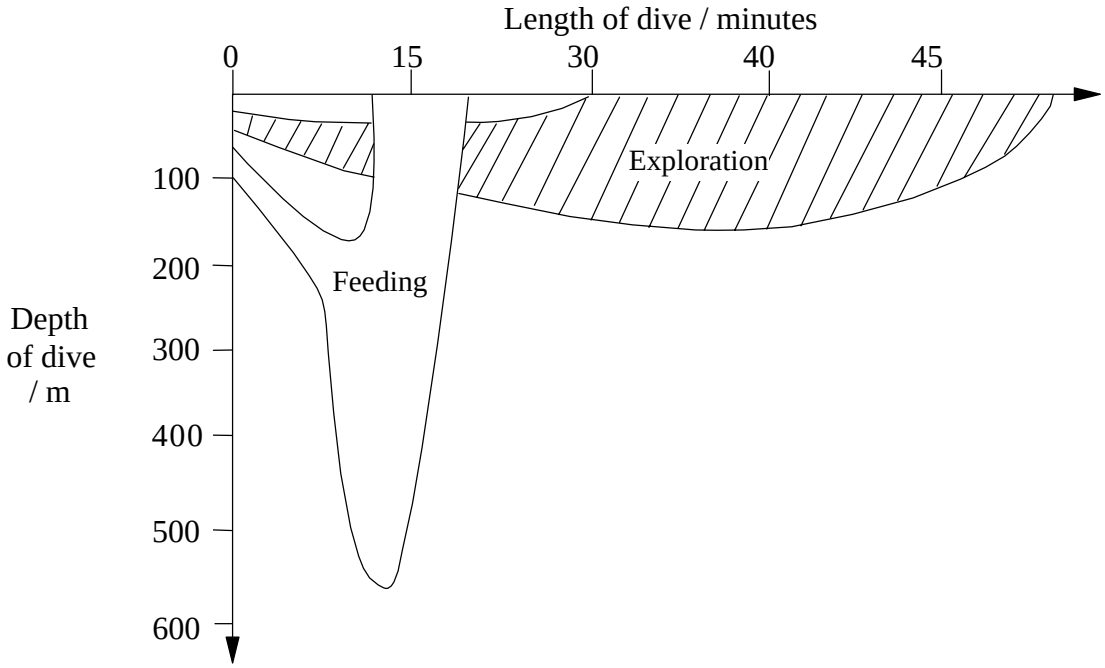
(This question continues on the following page)

(Question 1 continued)

Weddell seals (*Leptonychotes weddelli*) are mammals that live in the Antarctic Sea. They have lungs for breathing air, but can dive and remain underwater for up to 70 minutes, before coming up to breathe air again. They spend much of each year under the ice that covers the Antarctic Sea and must find holes through the ice to reach the air. They find new ice holes during **exploration dives**. Weddell seals catch and eat fish during **feeding dives**.

The diving behaviour of the Weddell seal has been studied and the depth of dives and the length of time spent on each dive are shown in the graph below.



(Source: Hempleman and Lockwood, (1978) *Physiology of Diving in Man and other Animals,* Arnold)

(c) (i) Compare the depth of feeding and exploration dives. *[1]*

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(ii) Suggest a reason for the difference. *[1]*

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(d) (i) Compare the length of time of feeding and exploration dives. *[1]*

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(ii) Suggest a reason for the difference. *[1]*

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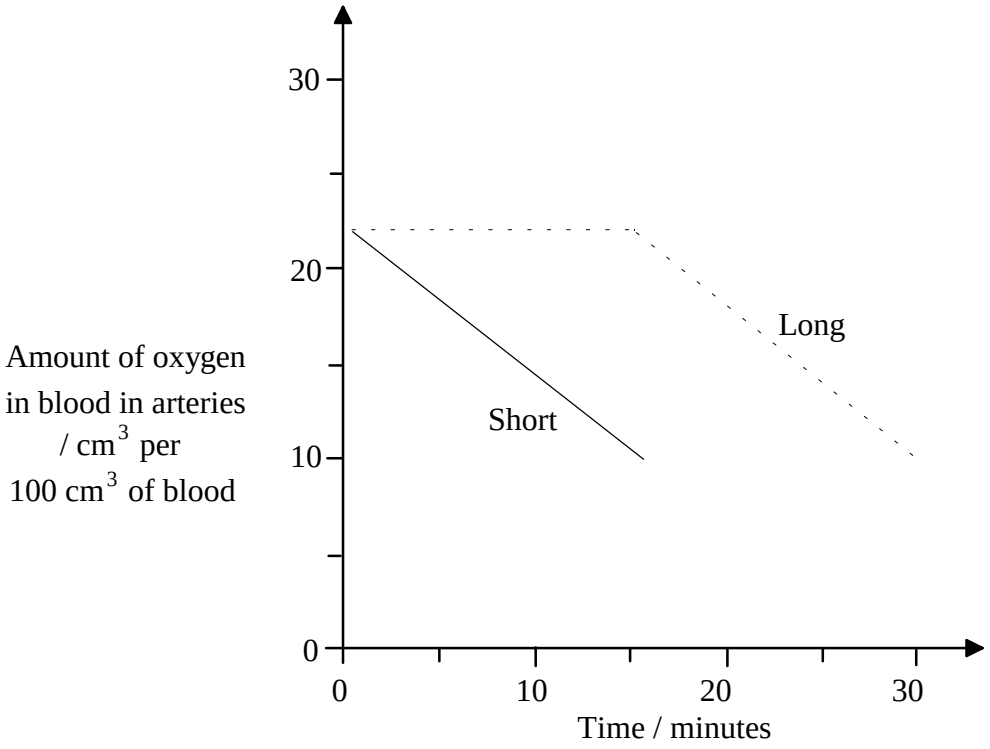
(This question continues on the following page)

(Question 1 continued)

Weddell seals have many adaptations for diving. They can increase the number of red blood cells per litre of blood by releasing them from stores in the spleen. They can store large amounts of oxygen in their muscles using myoglobin and they can close the blood vessels that carry blood to the muscles.

The oxygen content of blood in the arteries was measured during dives of different lengths. The results for a typical short dive and a typical long dive are shown in the graph below.



(Source: Zapol, *Scientific American* (1987), **256**, pages 80-85)

(e) Compare the decrease in oxygen content of the blood during the long dive with the decrease during the short dive. *[2]*

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(f) Discuss whether the seals were using **anaerobic** cell respiration during the long and short dives. *[3]*

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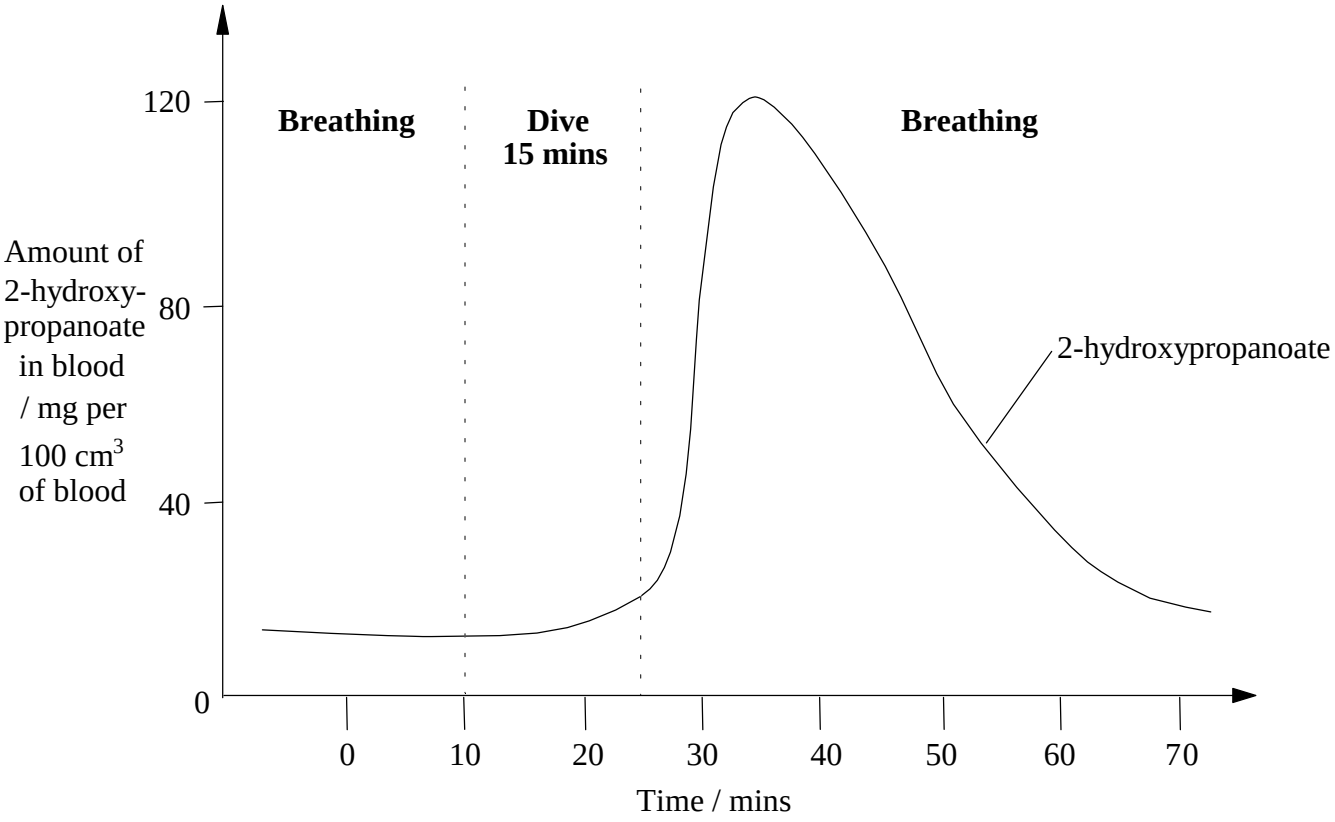
(This question continues on the following page)

(Question 1 continued)

Seals produce 2–hydroxypropanoate (lactate) during anaerobic respiration. The amounts of 2–hydroxypropanoate were measured in the blood of a seal before, during and after a 15 minute period in which the seal was kept underwater. The seal responded to being kept underwater in the same way as it does during a long dive. The results are shown in the graph below.



(Source: Hempleman and Lockwood, (1978) *Physiology of Diving in Man and other Animals*, Arnold,)

(g) Suggest reasons for the changes in 2–hydroxypropanoate in the blood of the seal, including the timing of these changes. *[3]*

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2. Mendel's Second Law is the Law of Independent Assortment. The first exception to this law was discovered in 1905, by Bateson, Saunders and Punnett. The two genes involved, which control flower colour and pollen grain shape in *Lathyrus odoratus* (the sweet pea), did not show independent assortment because they are part of the same linkage group.

(a) Define *linkage group*. *[1]*

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The allele for purple flowers (P) is dominant over the allele for red flowers (p).

The allele for long pollen (L) is dominant over the allele for short pollen (l).

A cross was made between a plant that was heterozygous for both genes and another plant that was homozygous for the recessive allele of both genes. Four different phenotypes were found in the offspring. The phenotypes and the percentage of each are shown in the table below.

Phenotypes of the offspring	**Percentage**
Purple flowers and long pollen grains	44
Purple flowers and short pollen grains	6
Red flowers and long pollen grains	6
Red flowers and short pollen grains	44

(b) Identify which of these offspring are recombinants. Give a reason for your answer. *[2]*

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(c) Explain briefly how the recombinants are formed when two genes are linked. *[2]*

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(Question 2 continued)

The genotypes of the two parent plants used in the cross are shown below.

$$\frac{P\ \ L}{p\ \ l} \qquad \frac{p\ \ l}{p\ \ l}$$

(d) Deduce the genotype of each of the offspring and list them in the table below. *[2]*

Phenotypes of the offspring	**Genotype**
Purple flowers and long pollen grains	
Purple flowers and short pollen grains	
Red flowers and long pollen grains	
Red flowers and short pollen grains	

(e) Determine how far apart, in centimorgans, the genes for flower colour and pollen shape are on a gene map of their linkage group. *[2]*

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3. (a) Outline the need for excretion in living organisms. *[2]*

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(b) Compare the composition of the blood in the renal artery and renal vein, by giving **two** differences in the table below. *[2]*

Blood in the renal artery	**Blood in the renal vein**

(c) Explain briefly the function of the loop of Henle in the human kidney. *[2]*

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(d) Deduce which part of the kidney has been damaged if protein is found in the urine. *[1]*

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SECTION B

*Answer **two** questions. Up to two additional marks are available for the construction of your answers. You may use the lined pages at the end of this paper or continue your answers in a continuation answer booklet. 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.*

4. (a) List **four** functions of membrane proteins. *[4]*

(b) Describe, with examples, the secondary structures of proteins. *[5]*

(c) Explain how proteins act as enzymes, including control by feedback inhibition in allosteric enzymes. *[9]*

5. (a) Describe the structure of triglycerides (fats). *[6]*

(b) Outline the use of fats in cell respiration. *[4]*

(c) Explain how the structure of the mitochondrion allows it to carry out its function efficiently. *[8]*

6. (a) Draw a diagram to show the structure of a motor neurone. *[5]*

(b) Outline the changes that lead to the depolarisation of an axon as an action potential travels along a neurone. *[5]*

(c) Explain how a nerve impulse is transmitted from a motor neurone to a muscle. *[8]*

7. (a) Draw a diagram to show the distribution of tissues in the root of a young dicotyledonous plant. *[5]*

(b) Outline **two** adaptations of hydrophytes. *[4]*

(c) Explain the process of water uptake by roots. *[9]*