



22146014

**BIOLOGY**  
**HIGHER LEVEL**  
**PAPER 2**

Candidate session number

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Friday 9 May 2014 (afternoon)

2 hours 15 minutes

Examination code

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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.
- Section A: answer all questions.
- Section B: answer two questions.
- Write your answers in the boxes provided.
- A calculator is required for this paper.
- The maximum mark for this examination paper is [72 marks].

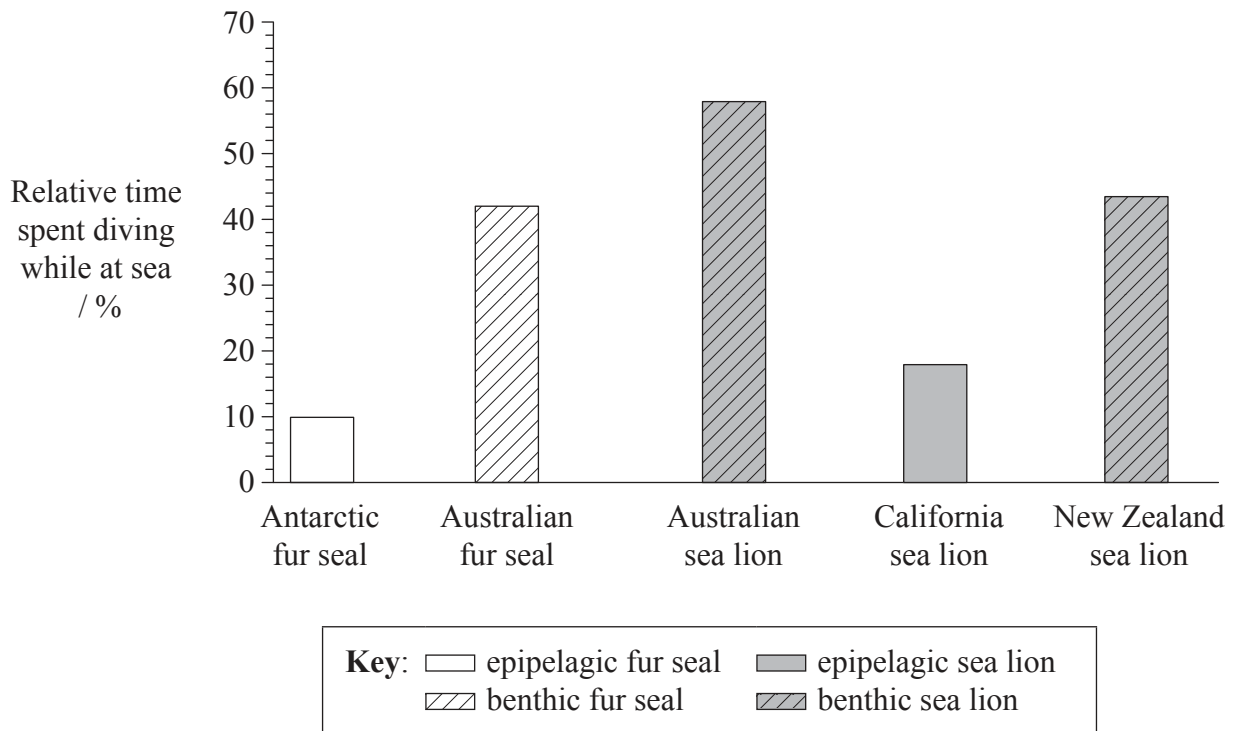


20EP01

**SECTION A**

Answer **all** questions. Write your answers in the boxes provided.

1. Pinnipeds are marine mammals with fins or flippers and include fur seals and sea lions. Some pinnipeds forage for prey near the surface (epipelagic) while others forage on the bottom of the sea (benthic). The graph shows the foraging behaviour and the relative time spent diving while at sea for five pinniped species.



[Source: Adapted from D. Costa *et al.* (2004) *International Congress Series*, 1275, pp. 359–366. ‘When does physiology limit the foraging behaviour of freely diving mammals?, with permission from Elsevier.]

- (a) State the relative time the Australian fur seal spent diving while at sea. [1]

.....%

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*(Question 1 continued)*

- (b) Using the data in the bar chart, deduce which factor has the most significant effect on the relative time spent diving while at sea. [2]

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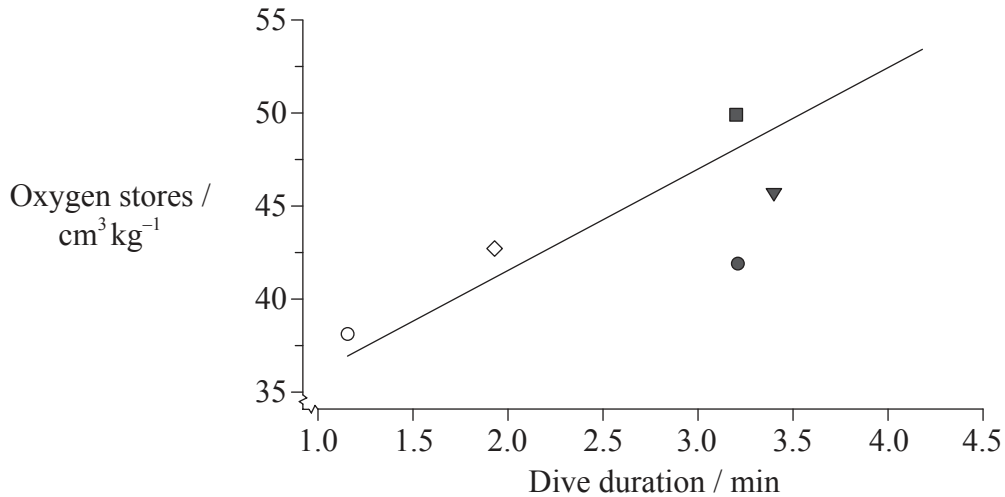


20EP03

**Turn over**

(Question 1 continued)

Different species are able to store different amounts of oxygen in their muscle tissues in preparation for diving. The graph shows the relationship between typical dive duration and oxygen storage in tissues in the same five species.



**Key:** ○ Antarctic fur seal (epipelagic)    ■ Australian fur seal (benthic)  
 ◇ California sea lion (epipelagic)    ▼ New Zealand sea lion (benthic)  
 ● Australian sea lion (benthic)

[Source: Reprinted from D. Costa et al. (2004) *International Congress Series*, 1275, pp. 359–366. ‘When does physiology limit the foraging behaviour of freely diving mammals?’. Copyright 2004, with permission from Elsevier.]

(c) State the oxygen stores for a New Zealand sea lion for a dive of 3.4 minutes. [1]

..... cm<sup>3</sup> kg<sup>-1</sup>

(This question continues on the following page)



20EP04

*(Question 1 continued)*

- (d) Using the data in the graph, analyse the correlation between dive duration and oxygen stores in the different species. [2]

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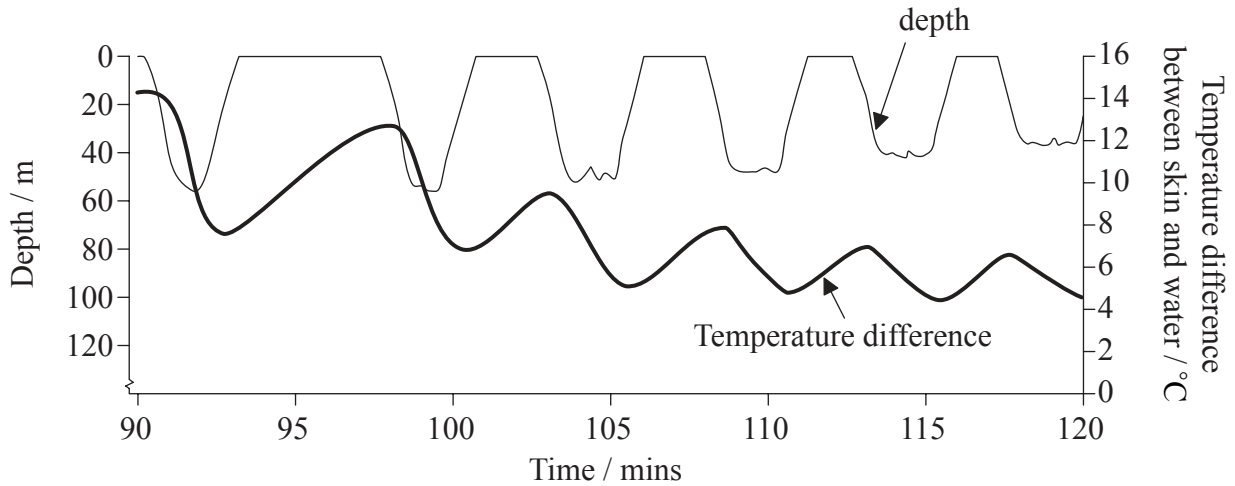


20EP05

**Turn over**

(Question 1 continued)

In another study on the Antarctic fur seal (epipelagic), scientists measured the temperature difference between the skin of diving seals and the water at all depths of the dives. The data shown is for one fur seal during one period of dives.



[Source: Adapted from I. Boyd (2000) 'Skin temperatures during free-ranging swimming and diving in Antarctic fur seals', *The Journal of Experimental Biology*, 203, pp. 1907–1914. Reproduced with permission of Company of Biologists Ltd via Copyright Clearance Center.]

(e) Describe the variations in the

(i) characteristics of each successive dive during the period investigated. [2]

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(ii) difference between the temperature of the skin and the water during the period investigated. [2]

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*(Question 1 continued)*

- (f) Explain **two** mechanisms **or** adaptations used in mammals to maintain a constant body temperature in cold environments that could be used by pinnipeds. [2]

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- (g) Suggest reasons for the observed changes occurring in temperature difference between skin and water during the dives in the sea. [3]

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*(This question continues on the following page)*



*(Question 1 continued)*

(h) Using the data, discuss reasons for pinnipeds diving for less than 3.5 minutes.

[3]

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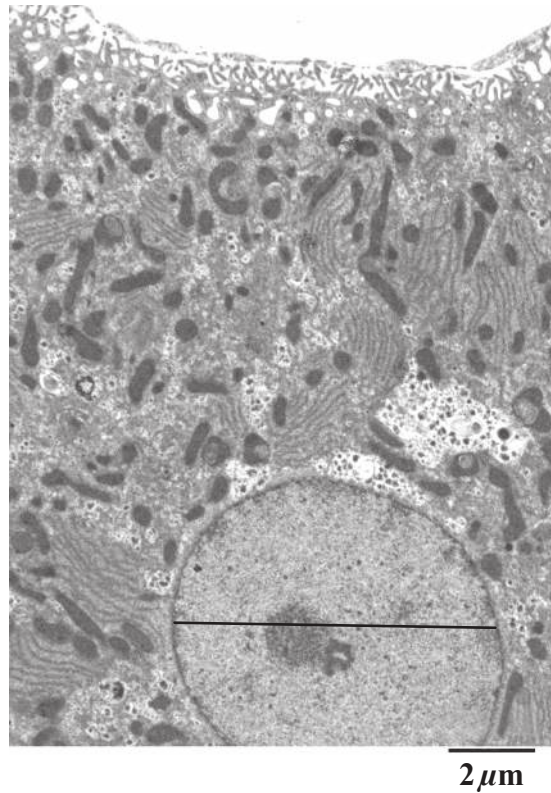
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20EP08



2. The following shows an electron micrograph of a liver cell.



[Source: adapted from J. L. Baratta et al. (2009) 'Cellular organization of normal mouse liver: a histological, quantitative immunocytochemical, and fine structural analysis', *Histochemistry and Cell Biology*, 131 (6), pages 713–726.]

(a) Calculate the

(i) magnification of the liver cell.

[1]

.....

(ii) actual diameter of the nucleus as marked on the electron micrograph.

[1]

..... μm

(This question continues on the following page)



20EP09

Turn over

(Question 2 continued)

(b) The electron micrograph is a higher magnification of a liver cell.



[Source: [www.histology.leeds.ac.uk/cell/assets/rough\\_ER2.gif](http://www.histology.leeds.ac.uk/cell/assets/rough_ER2.gif). Used with the permission of the Faculty of Biological Sciences, University of Leeds.]

(i) State the name of the organelle labelled X. [1]

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(ii) State its main function. [1]

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20EP10

*(Question 2 continued)*

(c) Outline the significance of the relationship between the surface area and volume of a cell. [2]

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20EP11

Turn over

3. The following shows a dichotomous key.



Bird W



Bird X



Bird Y



Bird Z

Dichotomous key to represent birds	
1. a.	The beak is relatively long and slender ..... <i>Certhidea</i>
b.	The beak is relatively stout and heavy ..... go to 2
2. a.	The bottom surface of the lower beak is flat and straight ..... <i>Geospiza</i>
b.	The bottom surface of the lower beak is curved ..... go to 3
3. a.	The lower edge of the upper beak has a distinct bend ..... <i>Camarhynchus</i>
b.	The lower edge of the upper beak is mostly flat ..... <i>Platyspiza</i>

[Source: <http://uoitbio2013.wordpress.com/taxonomy/dichotomous-keys/>]

(a) Using the dichotomous key above, identify the genus of bird W and bird Z. [1]

Bird W: ..... Bird Z: .....
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(b) Identify, with a reason, which bird could best eat insects that live in small cracks in trees. [1]

..... .....
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(This question continues on the following page)



*(Question 3 continued)*

- (c) The environment where these four birds live has changed and there are now fewer trees producing nuts and fruit but more insects available for food. Describe how natural selection in this situation could lead to evolution. [3]

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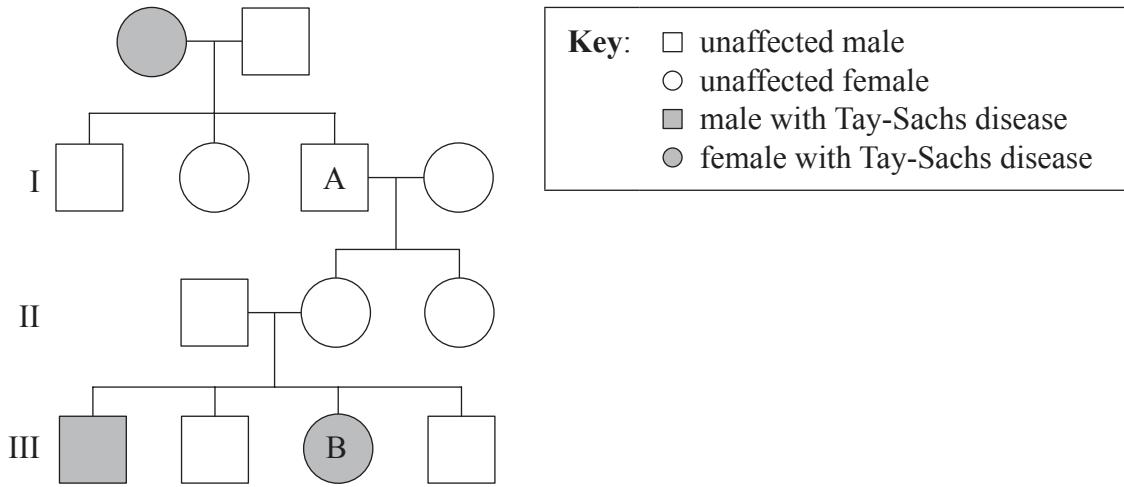
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4. In late-onset Tay-Sachs disease, neurological disorders slowly appear in adults. The pedigree chart shows four generations of a family affected by the disease.



(a) Determine the type of inheritance shown in the pedigree chart. [1]

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(b) At the gene locus for the disease, the alleles are N and n. Deduce the genotype of the person identified as

(i) A. [1]

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(ii) B. [1]

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**SECTION B**

Answer **two** questions. Up to two additional marks are available for the construction of your answers. Write your answers in the boxes provided.

5. (a) Outline the **four** levels of protein structure. [4]
- (b) Describe the lock and key model of enzyme activity and how the induced fit model extends it. [6]
- (c) Muscle contraction is a chemical process involving proteins. Explain how skeletal muscle contracts. [8]
6. (a) Draw a labelled diagram of the molecular structure of DNA, comprising of **four** nucleotides. [5]
- (b) Outline the effects of a base substitution mutation in the case of sickle-cell anemia. [5]
- (c) Giving **one** specific example, discuss genetic modification in organisms including the potential benefits and possible harmful effects. [8]
7. (a) State the source, substrate, products and optimum pH conditions for **one named** amylase. [4]
- (b) Outline the energy flow between trophic levels in a food chain. [6]
- (c) Explain the control of blood glucose concentrations in humans. [8]
8. (a) Distinguish between aerobic and anaerobic respiration. [5]
- (b) Outline the metabolic processes during germination of a starchy seed. [5]
- (c) Explain the processes involved in the Krebs cycle. [8]







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20EP17

Turn over

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20EP18

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20EP19

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20EP20