



22126008

**BIOLOGY
HIGHER LEVEL
PAPER 2**

Thursday 17 May 2012 (afternoon)

2 hours 15 minutes

Candidate session number

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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].



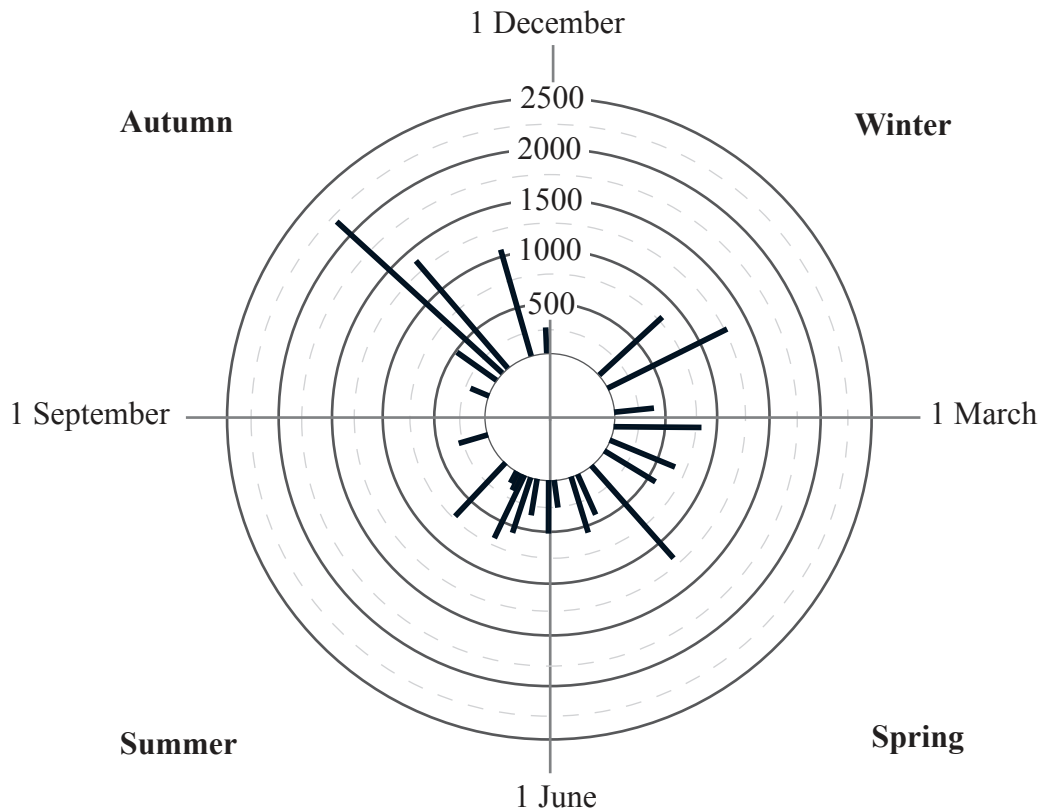
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SECTION A

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

- 1. Bottlenose dolphins (*Tursiops truncatus*) inhabit almost all tropical and temperate oceans between 45°N and 45°S. Over a two-year period, aerial surveys were carried out to investigate the seasonal distribution of these animals along the mid-Atlantic and eastern coastal waters of the USA. Sightings were recorded using a global positioning system (GPS) while flying in a regular pattern within approximately 65 km of the shore. A total of 12 760 dolphins were sighted over the two-year period and the data are summarized in the chart below.

Each bar corresponds to a single survey and the length of the bar corresponds to the total number of bottlenose dolphins counted in that survey. The circles with numbers indicate numbers of dolphins.



[Source: adapted from Leigh G. Torres, William A. McLellan, Erin Meagher and D. Ann Pabst (2005) 'Seasonal distribution and relative abundance of bottlenosedolphins, *Tursiops truncatus*, along the US mid-Atlantic Coast.' *Journal of Cetacean Research and Management*, 7 (2), pp. 153–161.]

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(Question 1 continued)

- (a) State the largest number of dolphins counted in a single survey. [1]

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- (b) Calculate the mean number of dolphins counted per survey for the winter season. [1]

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- (c) Compare the data for the dolphin populations in winter and summer. [2]

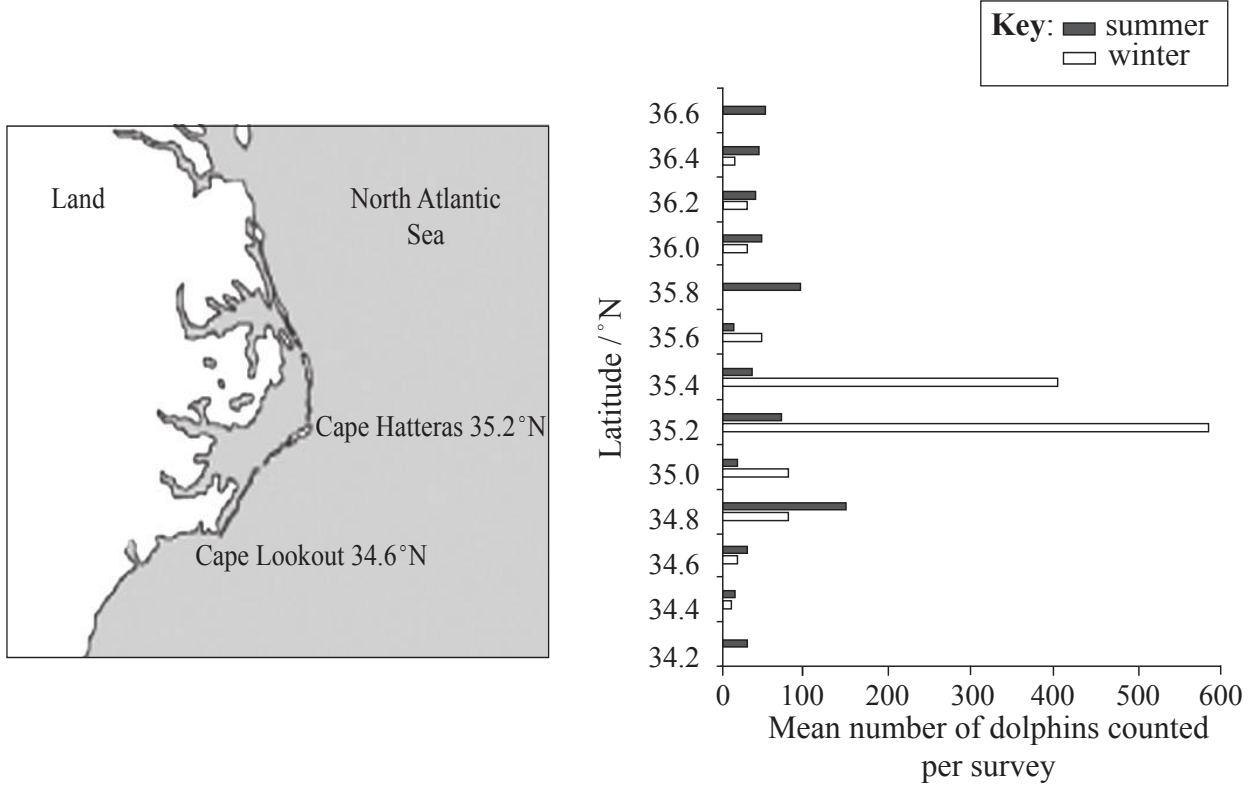
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(Question 1 continued)

As part of the same study, coastal aerial surveys were carried out over the same time period by flying parallel to the coast approximately 500 m offshore. The diagram below shows a map of the section of coast surveyed. The bar graph shows the seasonal data for summer and winter at the corresponding latitudes (°N). A total of 5431 bottlenose dolphins were sighted during these surveys.



[Source: adapted from Leigh G. Torres, William A. McLellan, Erin Meagher and D. Ann Pabst (2005) 'Seasonal distribution and relative abundance of bottlenosedolphins, *Tursiops truncatus*, along the US mid-Atlantic Coast.' *Journal of Cetacean Research and Management*, 7 (2), pp. 153-161.]

(d) (i) Compare the distribution of dolphins in summer and winter. [2]

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(Question 1 continued)

(ii) Suggest **one** reason for the differences in distribution.

[1]

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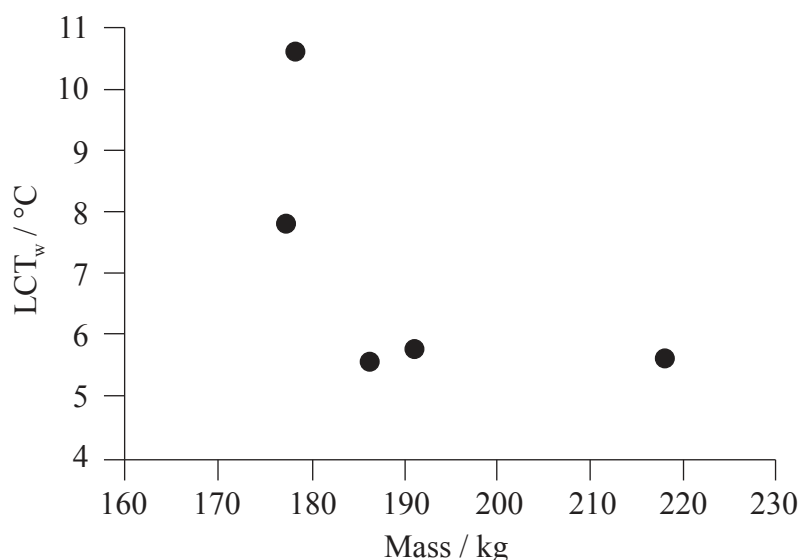
(Question 1 continued)

In a different study, researchers investigated the role of water temperature as a possible factor in the distribution of bottlenose dolphins. The rate of metabolism (measured as the rate of oxygen uptake per unit mass) of five captive adults was measured under a range of water temperatures. The rate of metabolism was found to increase significantly when the water temperature fell below a certain value known as the lowest critical water temperature (LCT_w). Below this temperature the body uses more energy to combat the cooling effect of the surrounding water. The data for these animals are summarized below.

Animal	Sex	Age / years	Mass / kg	$LCT_w / ^\circ C$
1	male	27	177.3	7.8
2	male	24	191.4	5.7
3	male	26	219.7	5.6
4	male	14	187.0	5.5
5	female	33	178.2	10.6

Adapted with permission from L.C. Yeates and D.S. Houser (2008) ‘Thermal tolerance in bottlenose dolphins (*Tursiops truncatus*).’ *Journal of Experimental Biology*, 211, pp. 3249–3257, Table 1. doi:10.1242/jeb.020610: The Journal of Experimental Biology: jeb.biologists.org

The graph below summarizes the relationship between LCT_w and body mass.



[Adapted with permission from L.C. Yeates and D.S. Houser (2008) ‘Thermal tolerance in bottlenose dolphins (*Tursiops truncatus*).’ *Journal of Experimental Biology*, 211, pp. 3249–3257, Figure 4. doi:10.1242/jeb.020610: The Journal of Experimental Biology: jeb.biologists.org.]

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(Question 1 continued)

- (e) Outline the relationship between body mass and LCT_w for male dolphins. [2]

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- (f) Suggest **one** reason for the high LCT_w measured for the female dolphin. [1]

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- (g) Evaluate the hypothesis that water temperature determines the range and distribution of bottlenose dolphins in the wild. [2]

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(Question 1 continued)

- (h) Explain how an increase in water temperature due to global warming could affect the distribution of bottlenose dolphins along the eastern coast of the USA. [2]

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- (i) Suggest how research into the range and distribution of bottlenose dolphins could benefit from international cooperation. [1]

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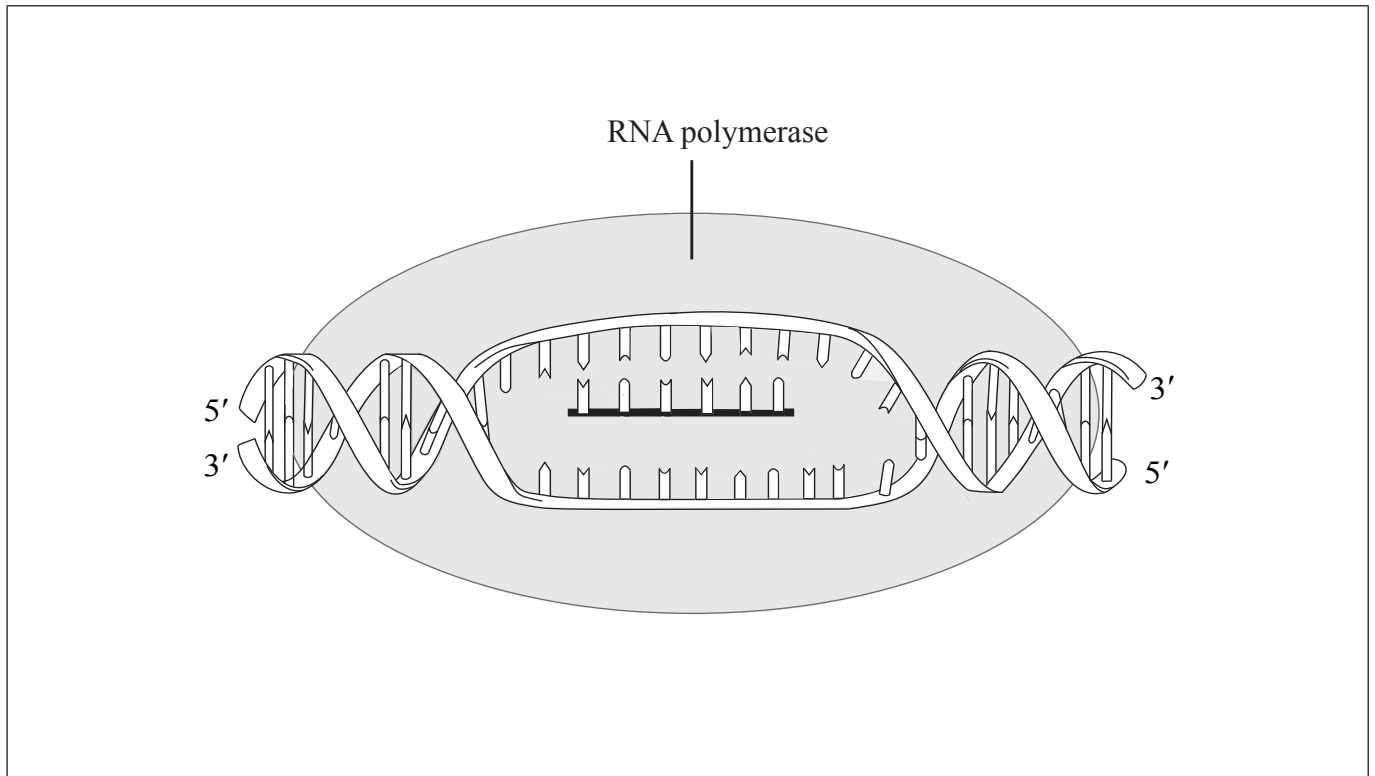
2. (a) DNA replication involves a number of enzymes including DNA polymerase. Identify **one** other enzyme involved in DNA replication. [1]

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- (b) Explain the role of Okazaki fragments in DNA replication. [2]

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- (c) The diagram below shows the process of transcription.



- (i) Label the sense and antisense strands. [1]
- (ii) Draw an arrow on the diagram to show where the next nucleotide will be added to the growing mRNA strand. [1]



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3. (a) Outline the mechanisms involved in the control of heartbeat. [3]

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- (b) Explain how the direction of blood flow in the heart is controlled. [2]

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4. (a) Outline the process of *in vitro* fertilization (IVF). [3]

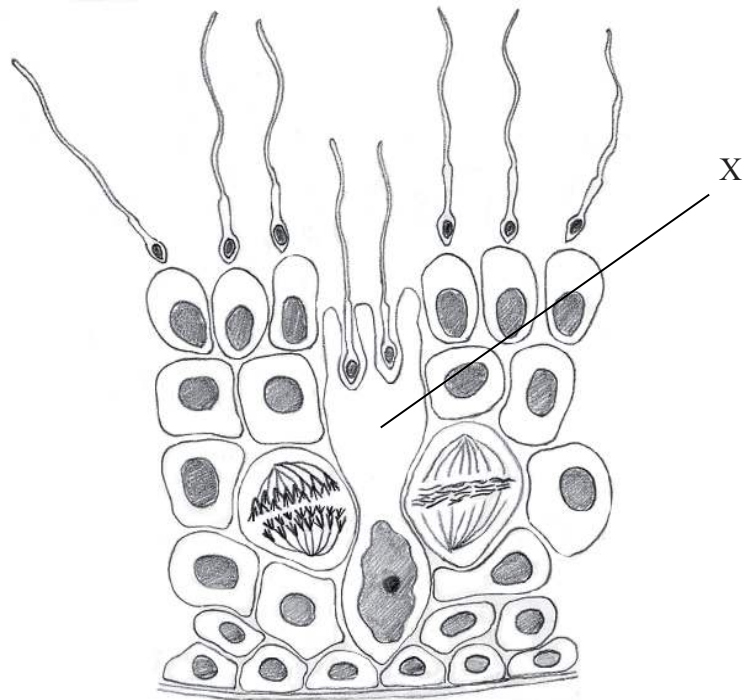
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(Question 4 continued)

(b) The diagram below shows a small portion of the tissue in a transverse section of a testis.



(i) Identify the cell labelled X. [1]

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(ii) Outline the function of this cell. [1]

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(Question 4 continued)

(c) Explain how meiosis results in genetic variation in gametes.

[2]

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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, with examples, the types of carbohydrate found in living organisms. [4]
- (b) Describe the importance of hydrolysis in digestion. [6]
- (c) Explain the effect of inhibitors on the activity of enzymes. [8]
6. (a) Describe the characteristics of stem cells that make them potentially useful in medicine. [5]
- (b) Outline a technique of gene transfer resulting in genetically modified organisms. [5]
- (c) Explain the use of karyotyping in human genetics. [8]
7. (a) Describe how plants carry out gas exchange in the leaves. [5]
- (b) Outline the causes and consequences of the enhanced greenhouse effect. [5]
- (c) Explain the role of limiting factors in photosynthesis. [8]
8. (a) Outline what is meant by homeostasis. [4]
- (b) Describe how body temperature is maintained in humans. [6]
- (c) Explain the processes occurring in the kidney that contribute to osmoregulation. [8]



