

**BIOLOGY
 HIGHER LEVEL
 PAPER 3**

Friday 10 May 2002 (morning)

1 hour 15 minutes

Name

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Number

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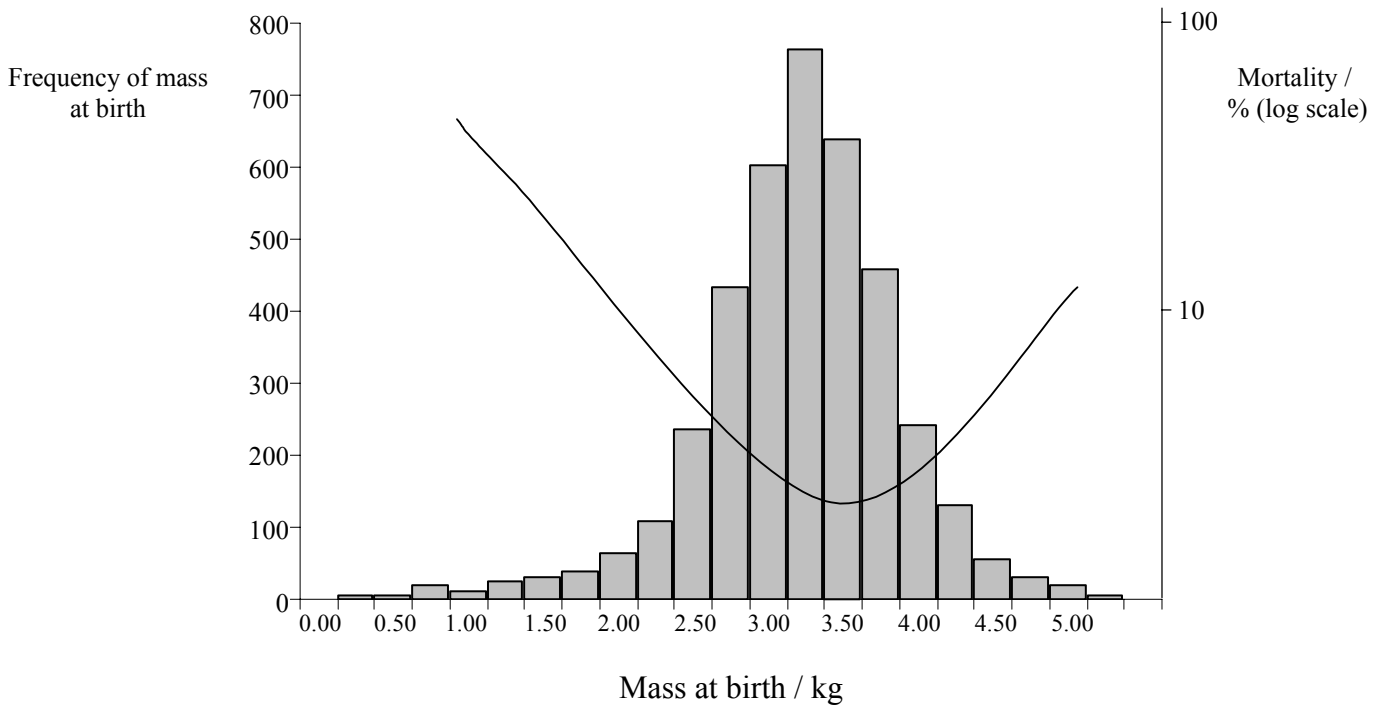
INSTRUCTIONS TO CANDIDATES

- 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	TOTAL	TOTAL
.....	/40	/40	/40

Option D – Evolution

D1. Researchers carried out a study on 3760 children born in a London hospital over a period of 12 years. Data was collected on the childrens’ mass at birth and their mortality rate. The purpose of the study was to determine how natural selection acts on mass at birth. The chart shows the frequency of babies of each mass at birth. The line superimposed on the bar chart indicates the percentage mortality rate (the children that did not survive for more than 4 weeks).



[Source: W H Dowerswell, (1984) *Evolution, A Modern Synthesis*, Heinemann Educational Books, page 101]

(a) Identify the mode value for mass at birth. [1]

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(b) Identify the optimum mass at birth for survival. [1]

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(c) Outline the relationship between mass at birth and mortality. [2]

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(Question D1 continued)

- (d) Explain how this data supports natural selection. [2]

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- (e) Suggest **one** environmental factor that could cause a low mass at birth. [1]

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D2. In a randomly breeding population of mice, 640 had black fur and 360 brown fur. Black fur is dominant to brown fur. The Hardy-Weinberg Principle ($p^2 + 2pq + q^2 = 1$) can be used to calculate allele and phenotype frequencies.

- (a) Calculate the frequency of the recessive allele. [1]

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- (b) Calculate the number of homozygous black mice in the sample. [2]

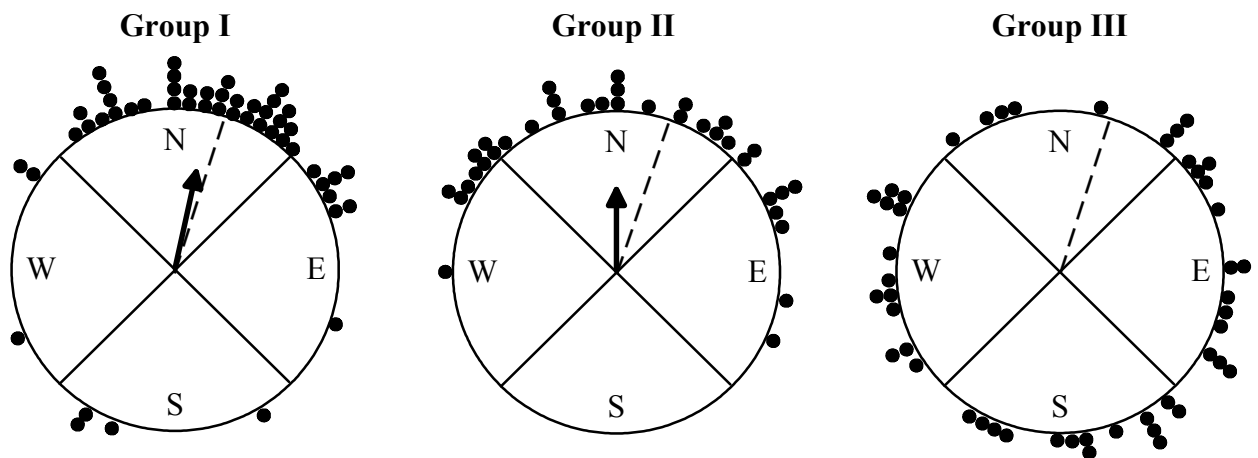
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E2. Homing pigeons are birds which, when transported away from where they have been raised, have the ability to fly back to their homes. Scientists have investigated how young pigeons used the magnetic field of the Earth to navigate. The birds had never left their homes before the experiment. The birds were taken far from their homes, released and the direction in which they flew was recorded. In the diagrams below, the centre of each circle represents the release site and the dots on the perimeter show the compass direction in which each bird flew. The dashed line (---) represents the direction to home. The length **and** direction of the arrow summarises the averaged results for each group in terms of number of birds and direction flown.

Group I : transported to the release site.

Group II : transported to the release site, then surrounded by a changing magnetic field for a time equal to the time of transport.

Group III : transported to the release site while being surrounded by a changing magnetic field.



One black dot = one bird

[Source: Wolfgang and Roswitha Wiltschko, (1996) *Journal of Experimental Biology*, 199, pages 29–38]

(a) Identify how many pigeons flew South. [1]

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(b) Compare the results from Group I with Group II by giving **one** similarity and **one** difference. [2]

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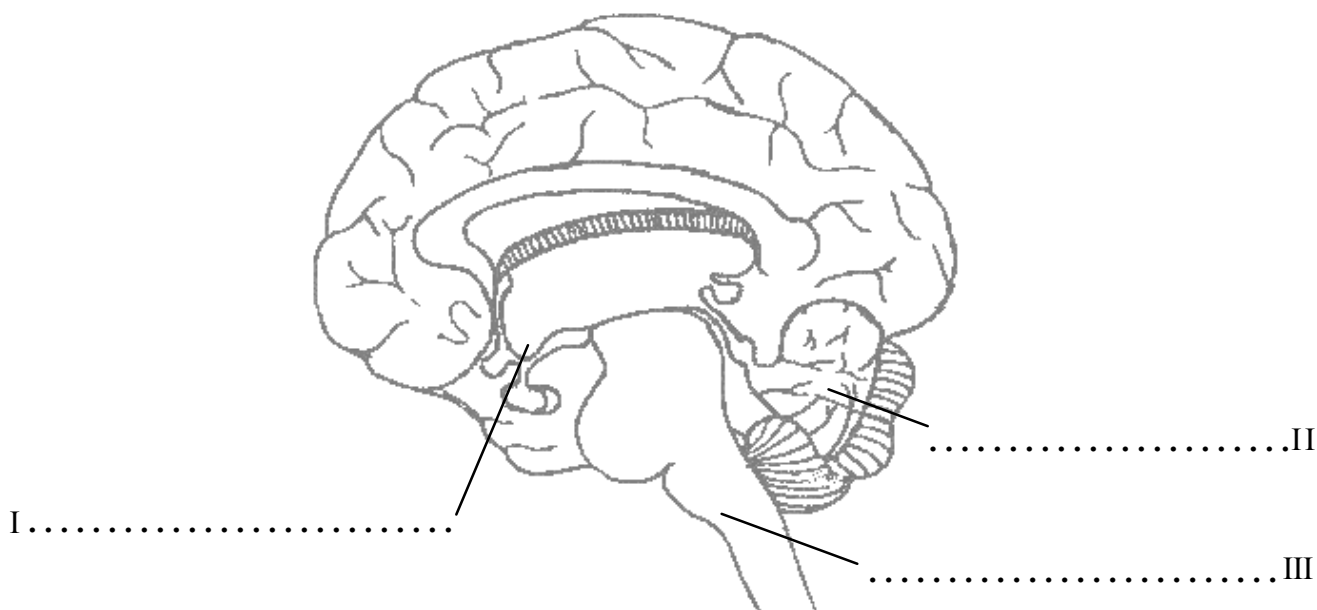
(c) Draw the direction arrow on the diagram for Group III. [2]

(d) Explain the type of behaviour shown by the pigeons. [2]

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E3. Annotate the diagram of the human brain to label the parts shown.

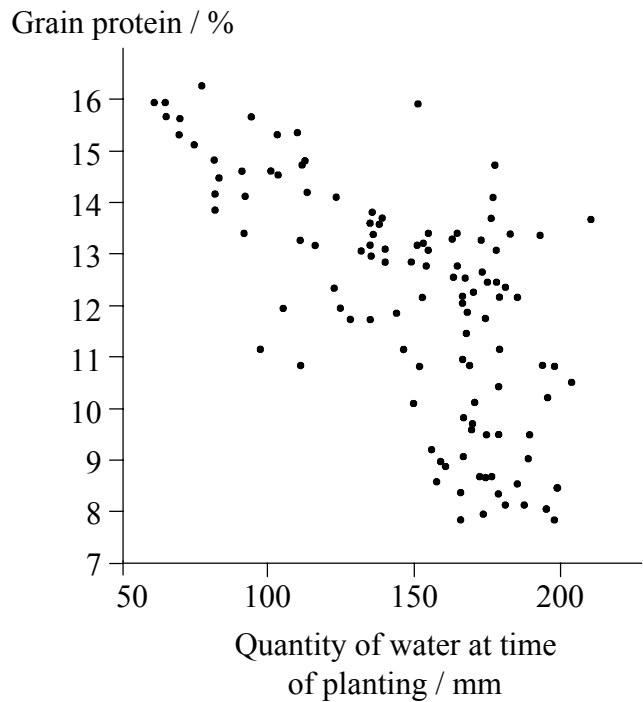
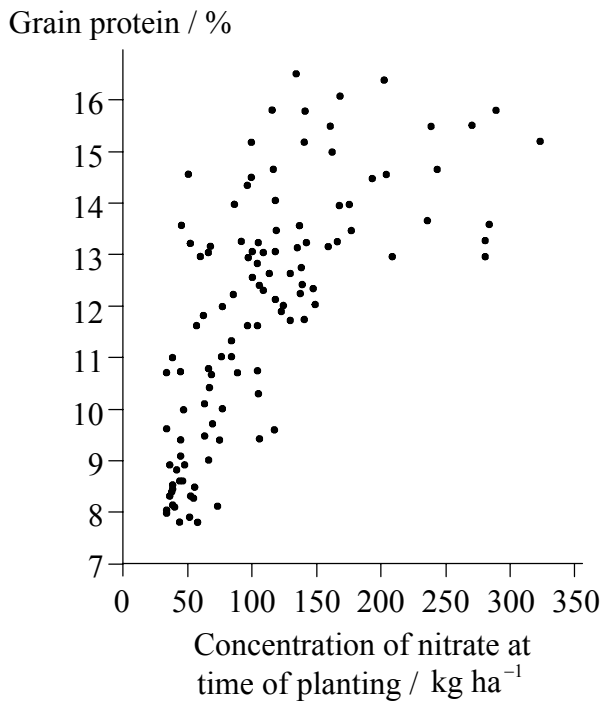
[3]



[Source: Glenn and Susan Toole, (1995) *Understanding Biology for Advanced Level*, Third Edition, page 539, Stanley Thornes]

Option F – Applied plant and animal science

F1. The protein content of harvested wheat grain depends on the concentration of nitrogen compounds and the water content in the soil at the time of planting. High quality (Prime Hard) grain contains at least 13 % protein while lower grade (malting) grain has 10.5 % to 13 % protein. In an experiment carried out in semi-arid soil in Queensland, Australia, over several years, researchers measured the protein obtained in wheat in different soil conditions.



Each dot represents the average protein of the plants in an area of 40 m².

[Source: R C Delal, *et al.*, (1997) *Australian Journal of Experimental Agriculture*, 37, pages 351–357]

(a) Identify the relationship between grain protein and soil nitrate. [1]

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(b) Compare the grain protein values at 75 mm water with those at 175 mm water. [2]

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(Question F1 continued)

- (c) A farmer who is growing malting grain wishes to change to Prime Hard grain. Using the data, suggest **two** ways in which this could be achieved. [2]

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- (d) A farmer has grown Prime Hard grain for 10 years but his yield (productivity) has been decreasing. Suggest **two** reasons for this, other than soil nitrate or soil water. [2]

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- F2.** (a) State the approximate number of years that hominid ancestors have used animal products. [1]

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- (b) Outline how improved breeds of animals for ploughing were achieved. [2]

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F3. (a) Explain gene manipulation in plant science with reference to Flavr-Savr™ tomatoes. [6]

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(b) Outline the arguments for and against the use of animals in research. [4]

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Option G – Ecology and conservation

G1. (a) Explain how parasitism differs from mutualism with reference to named organisms. [6]

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(b) Outline the role of international organisations in conservation. [4]

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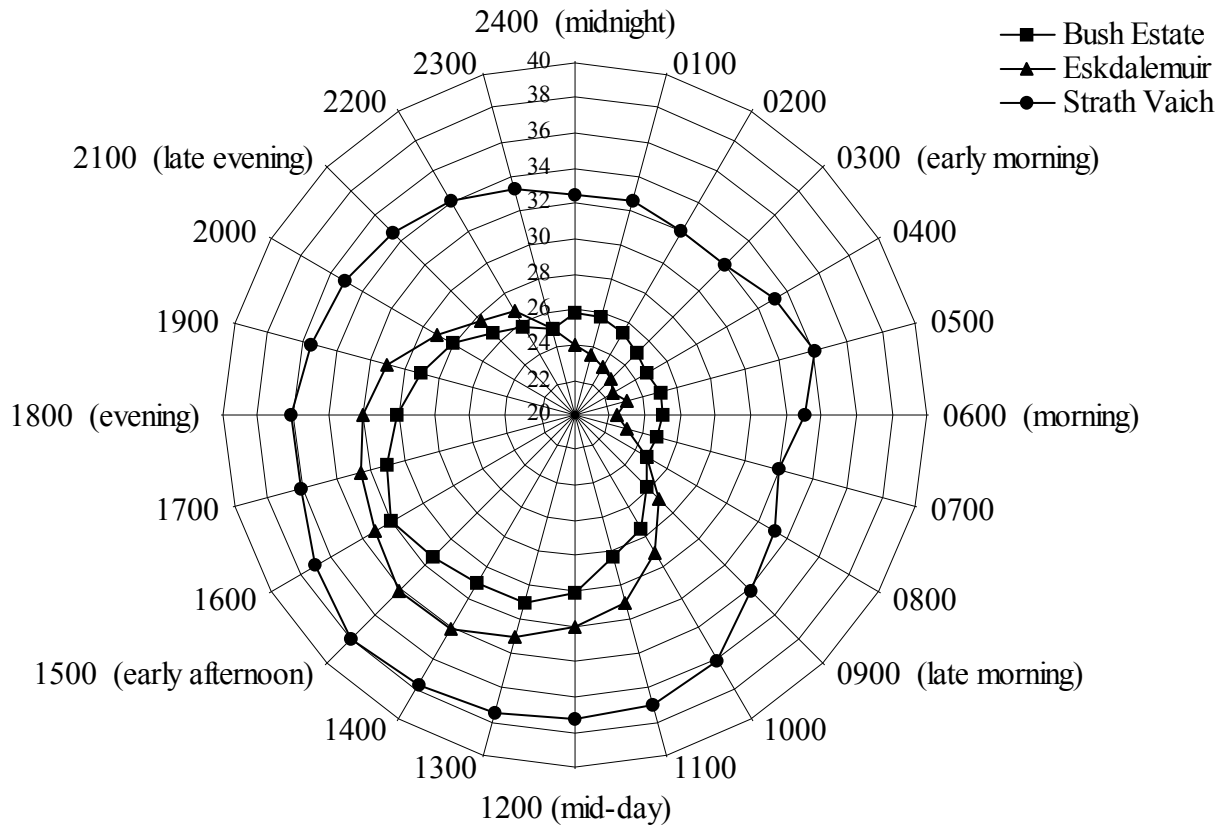
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G2. The amount of ozone in the air close to the ground changes during a 24-hour period. Under certain conditions, ozone is produced which increases its concentration in the air. The soil can absorb ozone and this decreases the amount of ozone in the air. The amount of ozone absorbed by the soil is much greater when the air is not moving. The graph shows changes in the amount of ozone in the air over a 24-hour period in three locations in Scotland. Each location was a rural area where human influence had no effect on the ozone concentration. The amount of ozone in the air was measured in parts per billion (ppb) with the outer ring representing 40 ppb and the central point representing 20 ppb.



[Source: modified from *State of the Environment Air Quality Report*, (2000) Scottish Environmental Protection Agency, page 40]

(a) Identify the **two** times of day when the concentration of ozone at Bush Estate was the same as at Eskdalemuir. [1]

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(Question G2 continued)

- (b) Compare the ozone concentrations at Eskdalemuir and Strath Vaich over the 24-hour period. [3]

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- (c) Deduce the conditions required for ozone to be produced. [1]

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- (d) Explain which of the three locations had the most wind. [2]

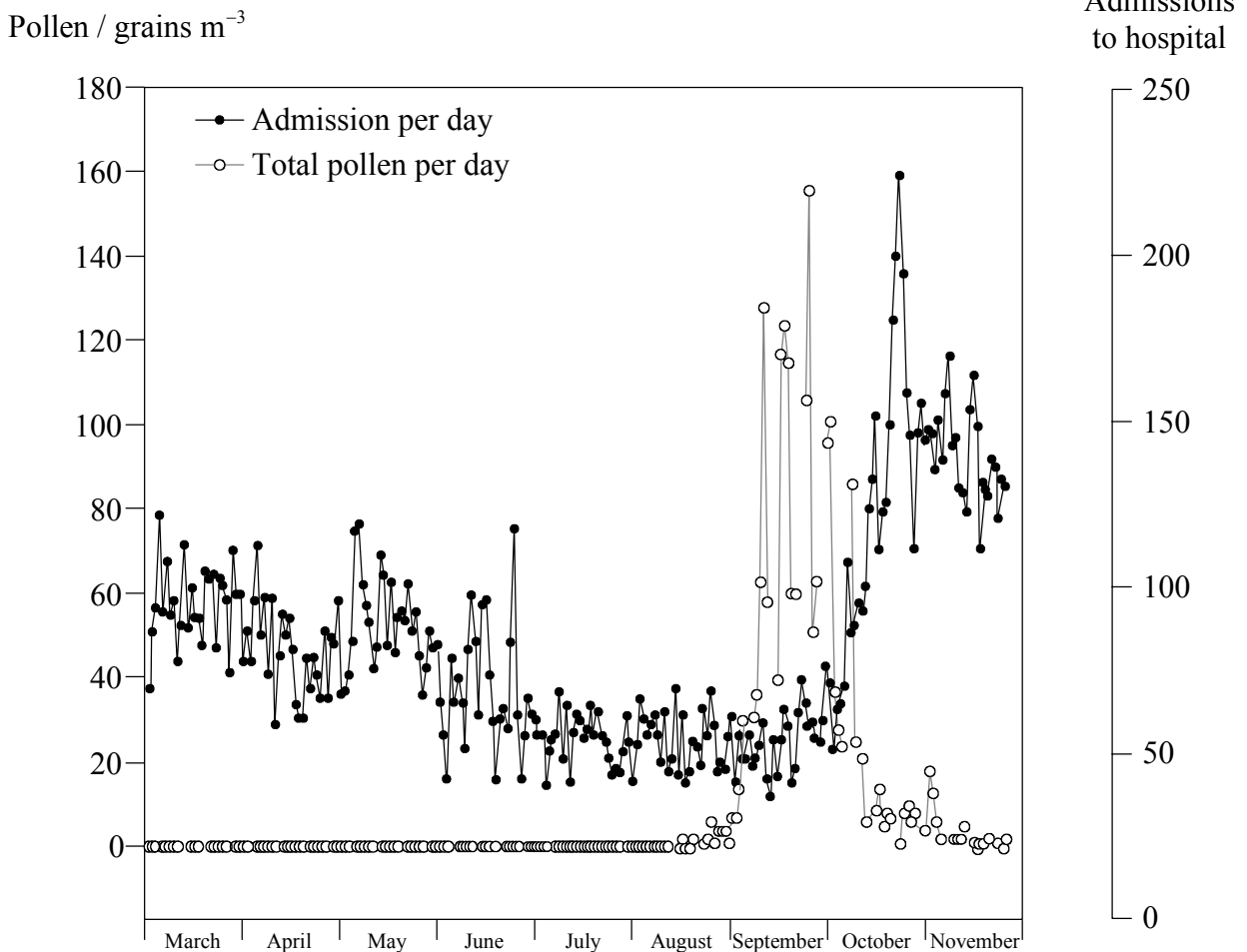
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- G3.** Outline the biological consequences of releasing raw sewage into a river. [3]

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Option H – Further human physiology

H1. The symptoms of asthma vary according to the time of year. A study was carried out in New York to determine if an increase in the amount of pollen in the air caused an increase in the number of asthma attacks. Over a period of 270 days, the number of people admitted to New York hospitals with asthma attacks was recorded. The graph below shows this data together with the pollen count.



[Source: Paul F Jamason *et al.*, (1997) *American Journal of Respiratory and Critical Care Medicine*, **156**, pages 1781–1788]

(a) Identify the greatest number of hospital admissions in one day.

[1]

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(Question H1 continued)

- (b) Describe how the numbers of hospital admissions changed over the period of study. [3]

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- (c) Evaluate whether the hypothesis that pollen in the air increases asthma attacks is supported by the data. [2]

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- (d) State **one** effect of asthma on the gaseous exchange system. [1]

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- H2.** (a) State where bile is synthesised. [1]

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- (b) Explain the role of bile in digestion. [2]

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