IB DIPLOMA PROGRAMME
PROGRAMME DU DIPLÔME DU BI
PROGRAMA DEL DIPLOMA DEL BI

M06/4/BIOLO/HP3/ENG/TZ1/XX

22066009

BIOLOGY
HIGHER LEVEL
PAPER 3

Friday 5 May 2006 (morning)

1 hour 15 minutes

Candidate session number

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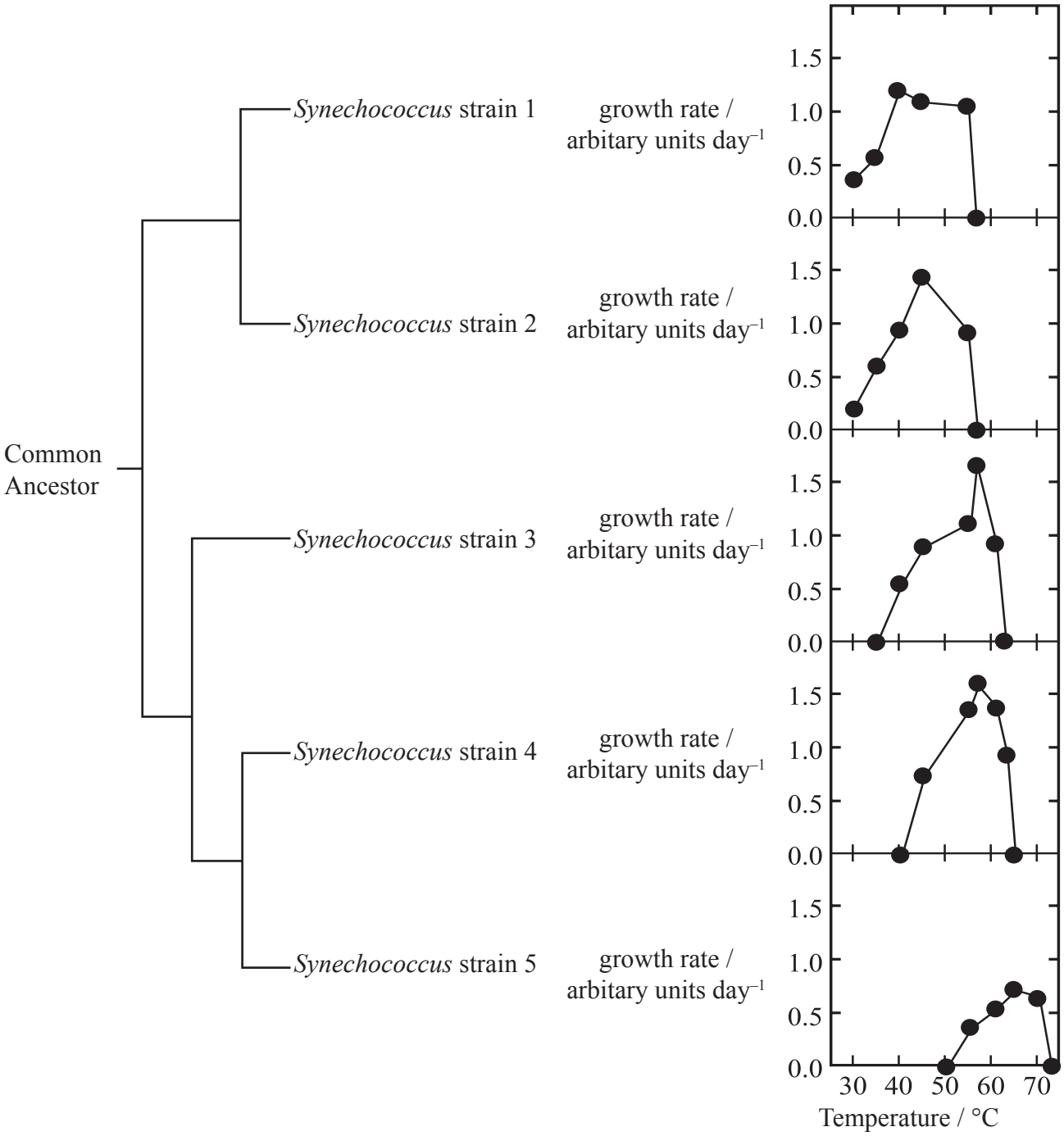
INSTRUCTIONS TO CANDIDATES

- Write your session number in the box 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 on answer sheets. Write your session number on each answer sheet, and attach them to this examination paper and your cover sheet using the tag provided.
- At the end of the examination, indicate the letters of the Options answered in the candidate box on your cover sheet and indicate the number of answer sheets used in the appropriate box on your cover sheet.

0120

Option D — Evolution

D1. The cyanobacterial genus *Synechococcus* is found in hot springs. Five strains (*Synechococcus* strain 1 to 5) were isolated from a hot spring in Oregon (USA) and tested for tolerance to high temperatures. The phylogeny in the figure below shows one common ancestor and relationships between the five strains. The growth rates of each of these five strains were determined at different temperatures.



[Source: S Miller and R W Castenholz, *Application and Environmental Microbiology*, (2000), **66**, pages 4222–4229]

(This question continues on the following page)

(Question D1 continued)

(a) (i) Identify, giving a reason, which strain would have the largest population after a growth period of 24 hours at a temperature of 45 °C. *[1]*

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(ii) State the names of **two** strains most distantly related on the phylogeny. *[1]*

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(b) Compare the tolerance to higher temperatures in these strains. *[2]*

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(c) Suggest **one** advantage this genus of cyanobacteria has acquired by evolving to survive at higher optimum temperatures. *[1]*

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(d) Deduce the evolutionary implications of the spread of tolerance to high temperatures demonstrated in these five strains of *Synechococcus*. *[2]*

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D2. (a) Outline **one** way in which preservation of past living organisms may have occured. *[2]*

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(b) State **two** conditions of pre-biotic Earth. *[1]*

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D3. (a) Outline the endosymbiotic theory of the origin of eukaryotes. *[4]*

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(b) Explain the biochemical evidence for the common ancestry of living organisms and the deficiencies associated with this evidence. *[6]*

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Option E — Neurobiology and Behaviour

E1. (a) Outline how natural selection can influence the development of behaviour patterns. *[4]*

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(b) Explain the effect of psychoactive drugs on synaptic transmission using **two** named examples. *[6]*

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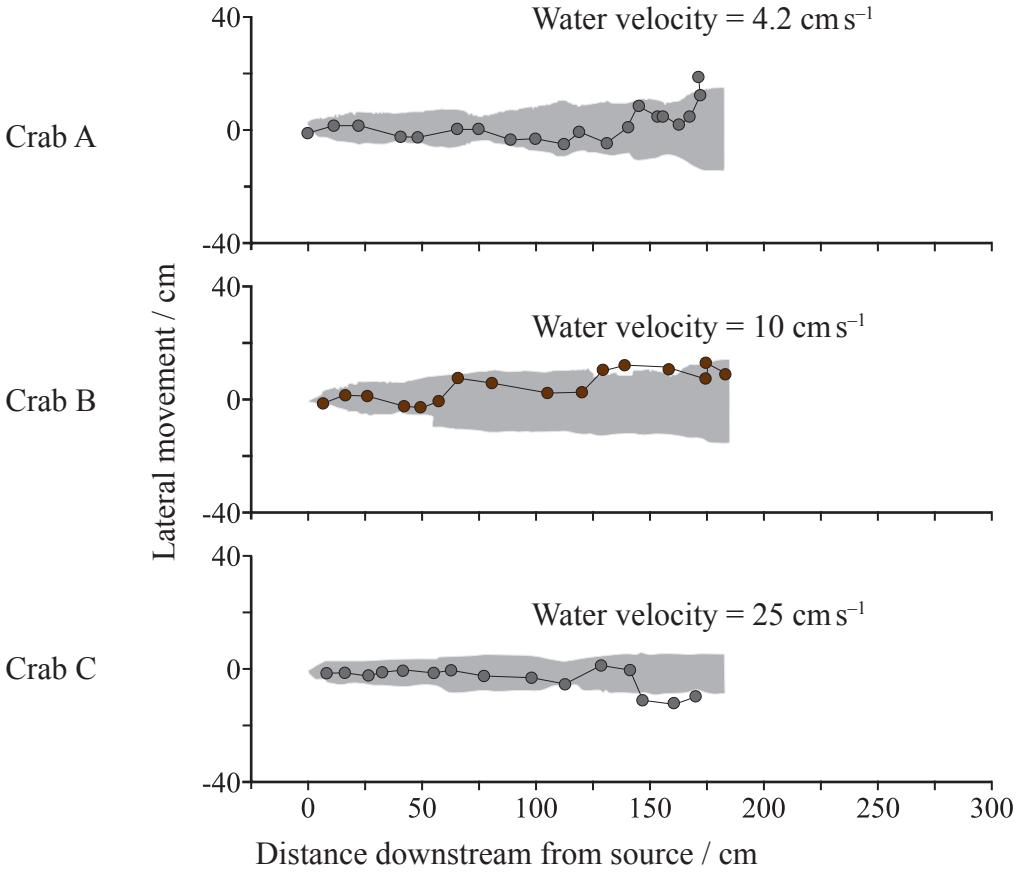
E2. Blue crabs (*Callinectus sapidus*) hunt clams in river streams. In response to being attacked the clams release chemicals. The hunting behaviour of the blue crabs was studied by recording their movements after the release of the chemical which was visualized by adding a dye (noted by shading in the figure below). The behaviour was studied and recorded under three different water velocities (expressed in $cm\,s^{-1}$).

Each graph below shows the movement of a single crab recorded at 1 s intervals, as it moves upstream towards the source of the chemical.



[Source: Adapted from Zimmer-Faust *et al.*, *Biology Bulletin*, (1995), **188**, pages 111–116]

(a) Identify which crab shows the greatest lateral movement. *[1]*

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(This question continues on the following page)

(Question E2 continued)

(b) Calculate the greatest speed of crab movement at 150 cm from the source of the chemical. *[1]*

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(c) Compare the effect of water velocity on the hunting behaviour of blue crabs. *[2]*

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(d) Discuss **two** other factors that could influence the outcome of this experiment. *[2]*

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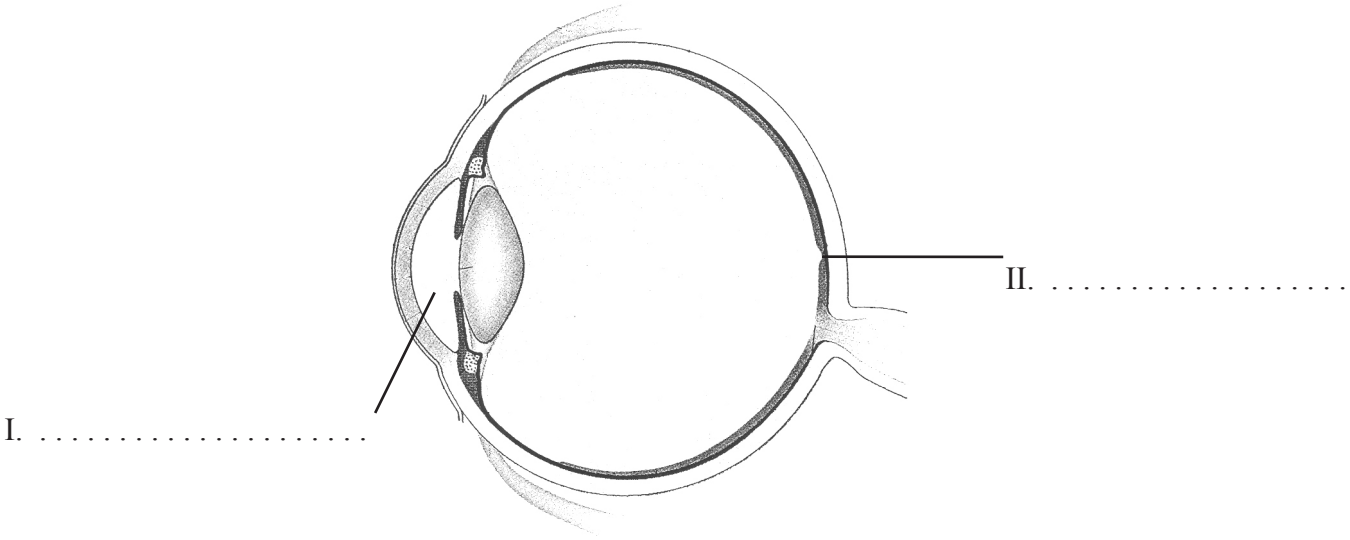
E3. (a) Label the diagram of the human eye shown below. *[2]*



[M. Jones and G. Jones, Advanced Biology 1997, Cambridge University Press]

(b) Define the term *kinesis*. *[1]*

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(c) State **one** effect of the parasympathetic nervous system. *[1]*

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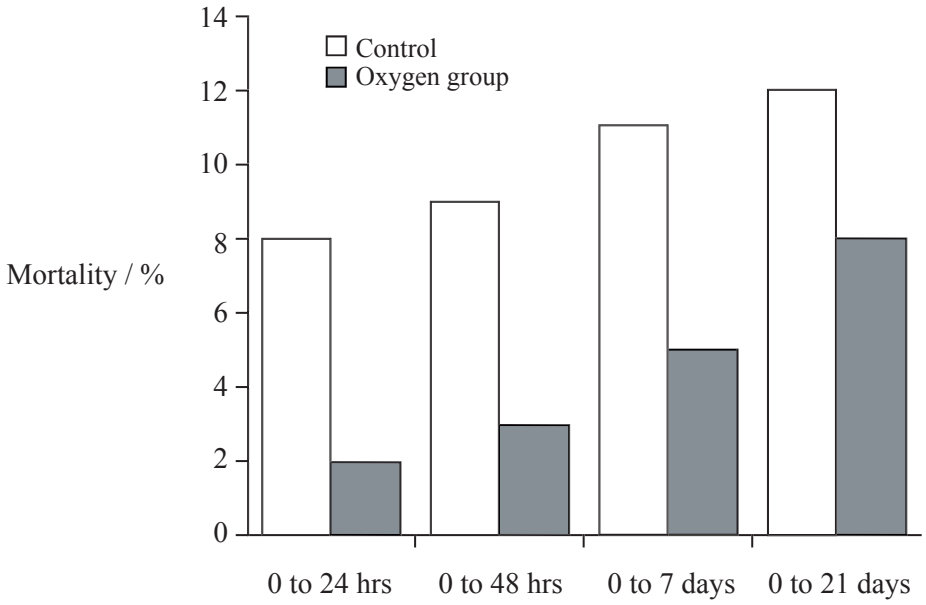
Option F — Applied Plant and Animal Science

F1. Piglets often die shortly after birth due to lack of oxygen during birth. In a study half the piglets in one litter were given 40 % oxygen for 20 minutes immediately after birth (oxygen group). The other half from the same litter only breathed air with the normal 20% oxygen (control). Mortality was recorded up to 21 days after birth.



[Source: P Herpin *et al*., *Journal Animal Science*, (2001), **76**, pages 5–10]

(a) State the percentage change in mortality after 24 hours. *[1]*

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(b) Describe the effect of oxygen on the mortality of the piglets during the first 21 days after birth. *[2]*

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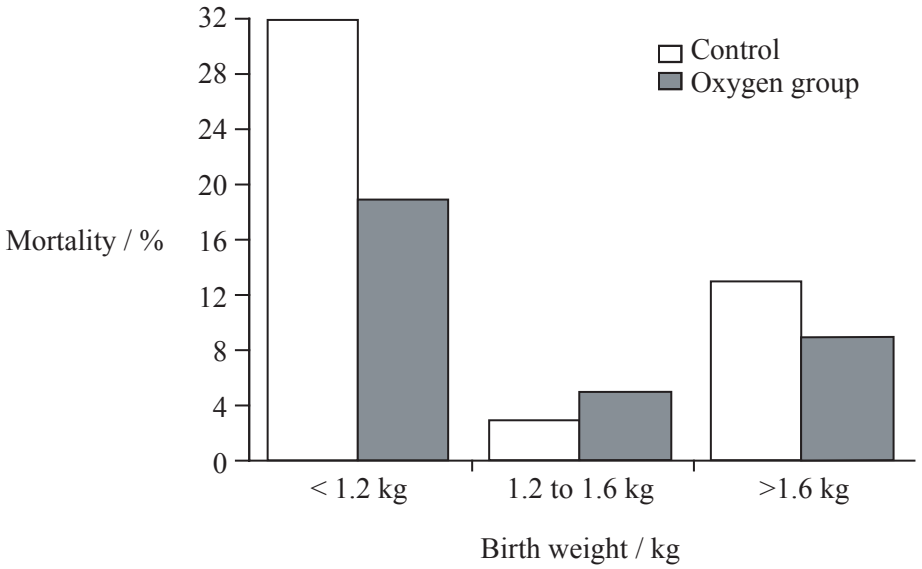
(Question F1 continued)

The piglets' mortality was also related to birth weight over a period of 21 days after birth. The figure below shows the differences between the oxygen group and the control group related to birth weight.



[Source: P Herpin *et al*., *Journal Animal Science*, (2001), **76**, pages 5–10]

(c) Analyse the mortality of the piglets in the control group with different birth weights. *[1]*

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(d) Evaluate the hypothesis that extra oxygen decreases mortality in piglets using all the data provided. *[2]*

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F2. (a) State **one** veterinary technique used to improve the fecundity of domesticated animals. *[1]*

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(b) (i) Define the term *plant productivity*. *[1]*

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(ii) Outline gene manipulation using an example from tomato culture. *[2]*

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F3. (a) Compare wind pollination and insect pollination. *[4]*

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(b) Discuss how day length variation can influence the production of flowers. *[6]*

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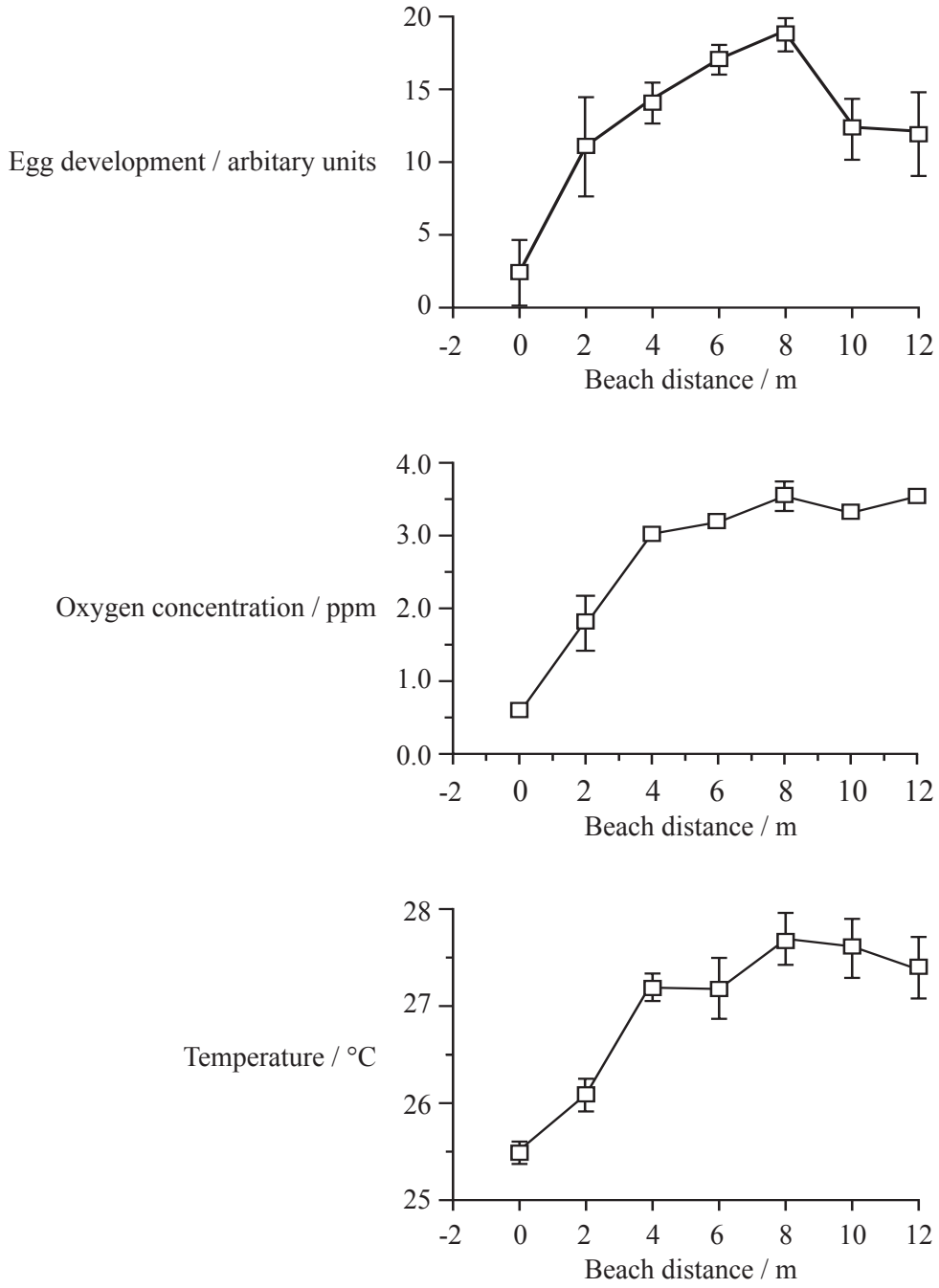
Option G — Ecology and Conservation

G1. The horseshoe crab (*Limulus polyphemus*) lay their eggs in the sand on beaches in the intertidal zone. The nesting site is selected on the basis of distance above the mean high tide line, oxygen concentration and temperature of the sand. Egg development was assessed after 10 days and recorded as an arbitary unit, the higher the value the more developed the eggs were. The "0 m" beach distance is based on the mean high tide line.



[Source: Penn and Brockmann, *Biology Bulletin*, (1994), **187**, pages 373–384]

(This question continues on the following page)

(Question G1 continued)

(a) State the optimum distance above the high tide line for egg laying. *[1]*

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(b) Describe the effect of oxygen concentration and temperature on egg development. *[2]*

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(c) Scientists believe that egg development was influenced by oxygen concentration, temperature of the sand and distance from the mean high tidal line.

(i) Evaluate this study with respect to these three factors. *[2]*

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(ii) State **one** other possible factor that might influence egg development. *[1]*

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G2. (a) Define the term *mutualism*. *[1]*

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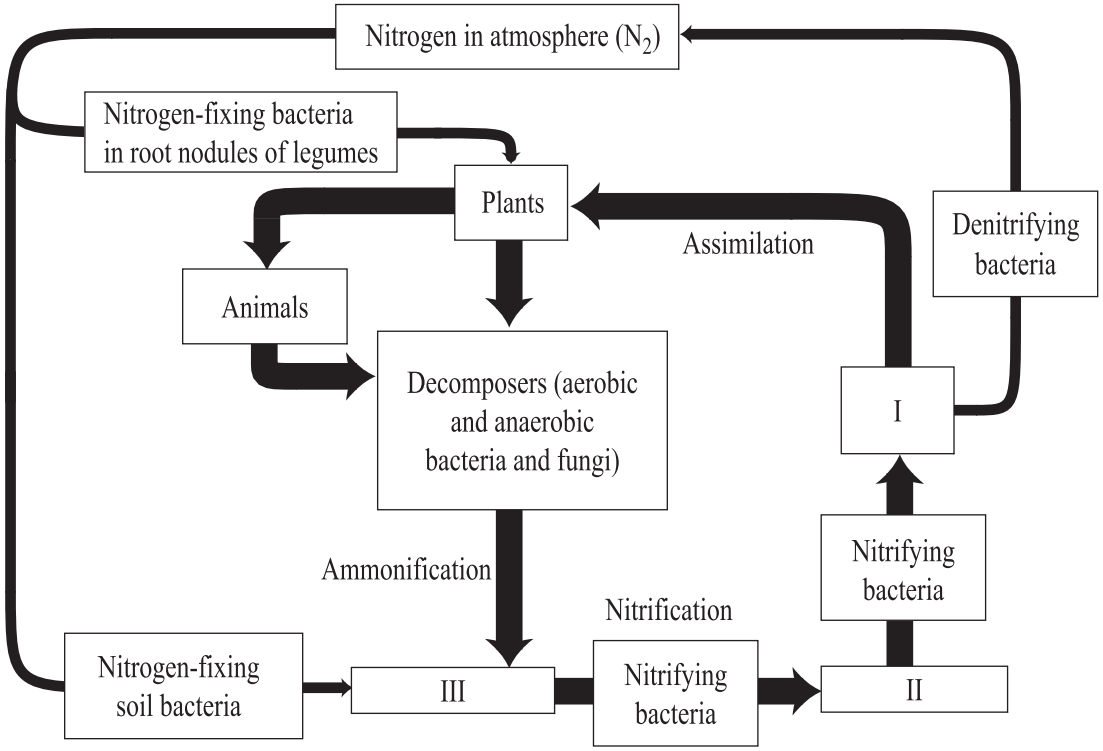
(b) Complete the diagram of the nitrogen cycle by naming the compounds. *[3]*



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II. . . . . .

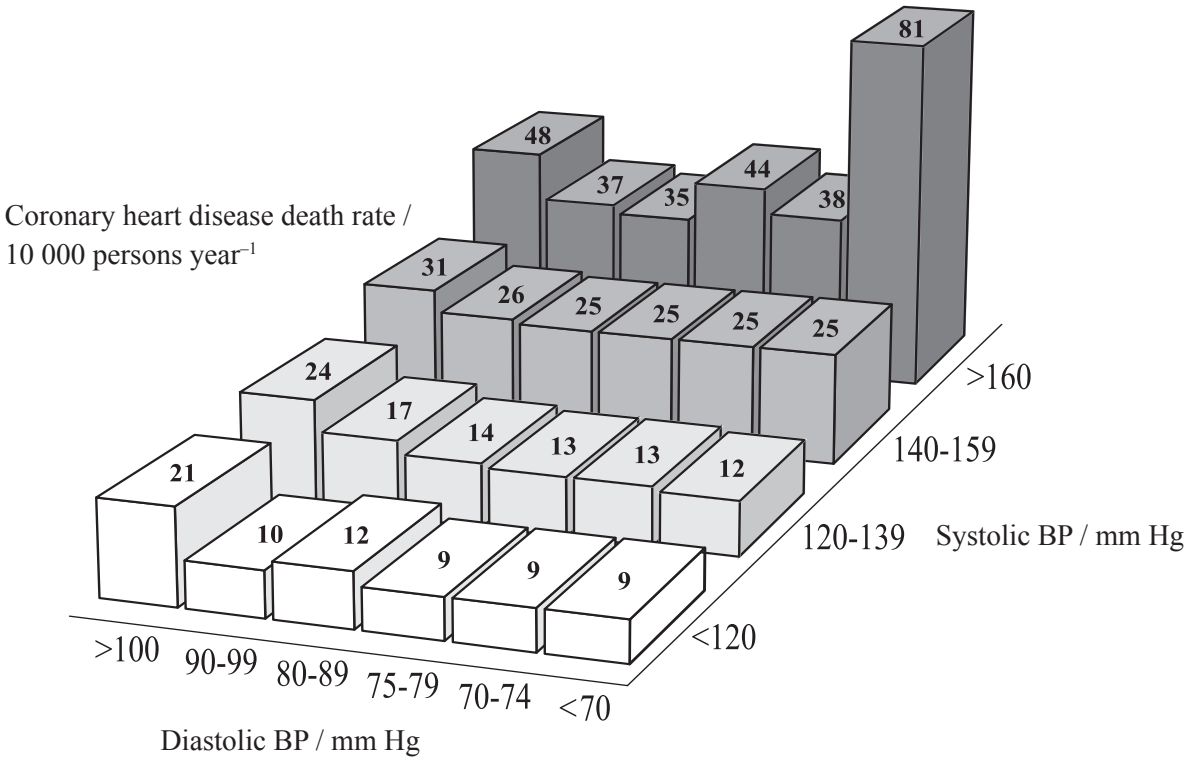
III. . . . . .

G3. (a) Outline the principles of efficient management of nature reserves. *[6]*

(b) Explain the effects of living organisms on the abiotic environment. *[4]*

Option H — Further Human Physiology

H1. High blood pressure (hypertension) is a major risk factor for coronary heart diseases. In a major study more than 316 000 males were followed for 12 years to investigate the effects of high blood pressure (BP). The diagram below shows the relationship between systolic and diastolic blood pressure and the effect on the death rate per 10 000 persons year^{-1}.



[Izzo *et al*., *Hypertension*, (2000), volume 35, **5**, page 1021 Lippincott Williams & Wilkins, USA.]

(a) Determine the death rate for a systolic blood pressure between 140–159 mm Hg and a diastolic blood pressure between 75–79 mm Hg. *[1]*

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(This question continues on the following page)

(Question H1 continued)

(b) Describe the effect of systolic blood pressure and diastolic blood pressure on the death rate. *[2]*

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(c) (i) Calculate the minimum difference between systolic and diastolic blood pressure where the death rate is highest. *[1]*

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(ii) Evaluate the impact of differences between systolic and diastolic pressure on death rate. *[3]*

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H2. (a) State **one** type of hormone and give a named example. *[1]*

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(b) Outline the action of endopeptidases and exopeptidases. *[2]*

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H3. (a) Describe the process of erythrocyte and hemoglobin break down in the liver. *[5]*

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(b) Explain the dissociation curve of adult hemoglobin and fetal hemoglobin. *[5]*

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