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BIOLOGY
STANDARD LEVEL
PAPER 3

Thursday 15 May 2008 (morning)

1 hour

Candidate session number

0	0								

INSTRUCTIONS TO CANDIDATES

- Write your session 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 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.

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Option A — Diet and Human Nutrition

A1. The body mass index (BMI) is a measure of how heavy a person is for their particular height. Doctors use it to classify adults into the following categories:

Normal	20.1 – 25
Overweight	25.1 – 30
Obese	30.1 – 40
Very obese	over 40

Scientists collected information on 11 252 pregnant Australian women and their babies. All values are statistically significant.

Characteristic	BMI category of mother			
	Normal	**Overweight**	**Obese**	**Very obese**
Mother	Those sharing characteristic / %			
Smoker	13.0	14.4	16.6	16.5
Drinks alcohol while pregnant	2.0	1.8	1.1	1.2
General high blood pressure	0.5	1.2	3.0	6.9
High blood pressure disorder during pregnancy	2.4	5.6	9.1	14.5
Diabetic	0.0	0.6	1.4	2.8
Vaginal delivery	77.7	70.5	64.8	57.2
Caesarean delivery	22.3	29.5	35.2	42.8
Baby				
Stillborn / not living when delivered	0.5	0.6	0.6	0.8
Birth defect	1.2	1.4	1.9	4.0
Respiratory problems	1.5	1.7	2.2	2.0
Needed mechanical ventilation	0.4	0.3	0.7	1.2
Low blood sugar	0.6	0.3	1.2	2.8
Jaundice*	28.2	27.9	26.5	33.9
Premature	6.7	7.2	7.0	10.4
Require intensive care	4.3	4.0	5.3	10.9

[Source: Callaway LK et al. The prevalence and impact of overweight and obesity in an Australian obstetric population. MJA 2006; 184: 56-59. © Copyright 2006. *The Medical Journal of Australia* - reproduced with permission.]

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* Jaundice: is a temporary condition in newborns due to liver immaturity which causes yellowing of skin and whites of the eyes.

(This question continues on the following page)

(Question A1 continued)

(a)   State the percentage of very obese women who had high blood pressure disorders during pregnancy.   *[1]*

. . . .%

(b)   Calculate the percentage increase in the occurrence of diabetes in women who were classified as very obese compared to those classified as overweight.   *[1]*

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(c)   Outline the relationship between the occurrence of birth defects and BMI classification.   *[1]*

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(d)   Suggest why a higher percentage of babies born to very obese mothers required admission to intensive care.   *[3]*

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A2. (a) Define the term *nutrient*. *[1]*

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(b) Outline the functions of **two** named vitamins. *[2]*

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(c) Explain why the difference between saturated fats and unsaturated fats is important in a healthy diet. *[3]*

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A3. (a) Distinguish between vegan diets and vegetarian diets. *[1]*

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(b) Outline how the human body uses cholesterol. *[2]*

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(c) Suggest reasons why human populations can suffer from malnutrition. *[3]*

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Option B — Physiology of Exercise

B1. Following surgery, illness or injury, adults experience loss of muscle mass and muscle strength during the time they take to recover. Scientists measured the muscle strength and muscle mass in male patients who either took testosterone or a placebo to aid muscle recovery, or who followed a low or high activity exercise programme. A placebo is a control treatment without testosterone. The results are shown in the bar charts below.

Key: ☐ placebo   ⬜ testosterone   ⬚ low activity exercise   ▦ high activity exercise
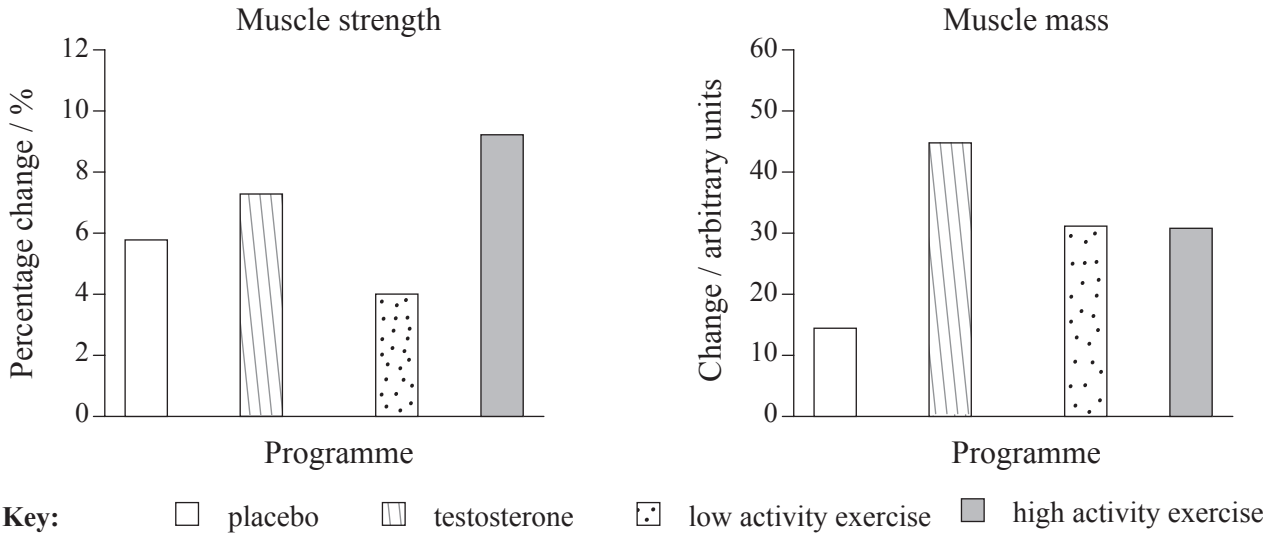
[Source: adapted from D. H. Sullivan *et al.*, (2005), 'Effects of Muscle Strength Training and Testosterone in Frail Elderly Males', *Medicine and Science in Sports and Exercise*, **37** (10), 1664-1672, © Lippincott Williams & Wilkins, USA]

(a) State which programme produced the greatest increase in muscle mass.   *[1]*

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(b) Calculate the percentage increase in muscle strength for patients using high activity exercise compared to those on a low activity exercise programme.   *[1]*

........%

(c) Compare the effects of low and high activity exercise on both muscle strength and muscle mass changes.   *[1]*

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(This question continues on the following page)

(Question B1 continued)

    (d)   Using the data, suggest how patients should be treated to improve muscle recovery after illness.   *[3]*

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B2. (a)   State the sub-divisions of the skeleton.   *[1]*

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    (b)   Describe the variety of antagonistic movements that occur at the human hip and knee joints.   *[2]*

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    (c)   Explain the changes to skeletal muscle during contraction.   *[3]*

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B3. (a) State the product of anaerobic respiration that causes oxygen debt in human muscle.   *[1]*

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(b) Outline the role played by myoglobin in skeletal muscle.   *[2]*

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(c) Explain the roles of adrenaline in the functioning of actively contracting muscle.   *[3]*

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Option C — Cells and Energy

C1. Mitochondrial electron transport defects (called mitochondrial myopathy) causes tiredness at low levels of exercise and varies from mild to severe. Scientists measured oxygen delivery to cells and oxygen use in cells of thirty-five patients with mitochondrial myopathy. The results were compared to a control group of thirty-two healthy individuals. The results are shown in the two charts below.

Oxygen delivery to cells   Oxygen use in cells

Key: ⊙ mitochondrial myopathy group   ○ control group
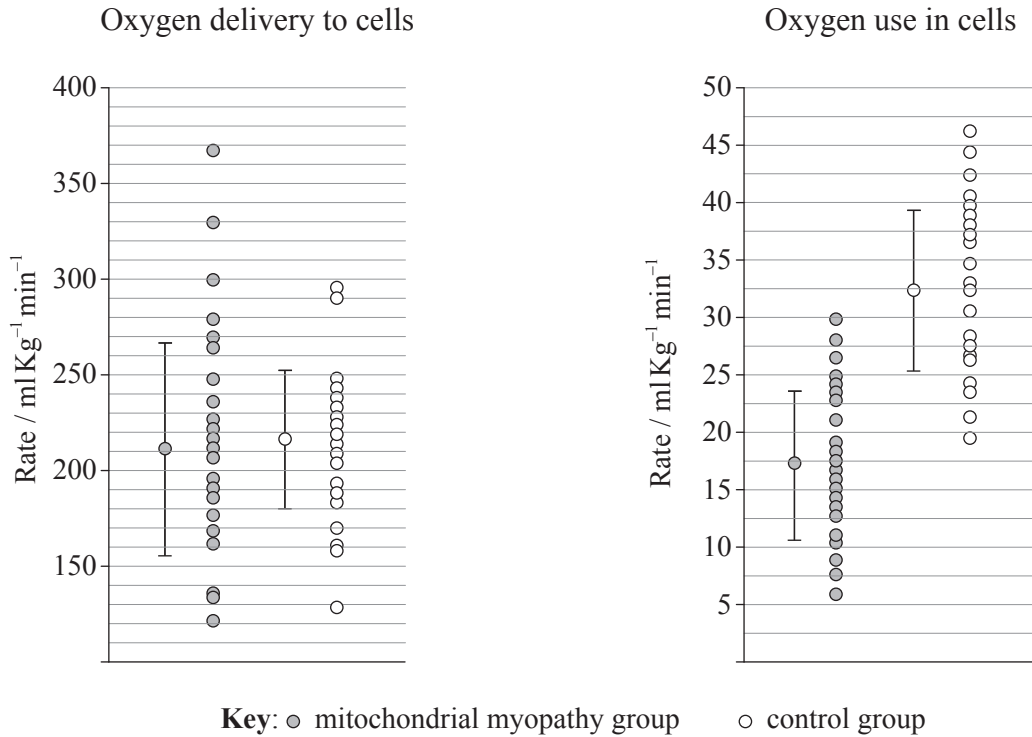
[Source: adapted from T. Taivassalo and R. G. Haller, (2006), 'Exercise and training in mitochondrial myopathies', *Medicine and Science in Sports an Exercise*, **37** (12) 2094-2101, © Lippincott Williams & Wilkins, USA]

(a)   State the mean value for oxygen delivery to cells in patients suffering from mitochondrial myopathy.   *[1]*

    . . . .

(b)   Calculate the percentage difference of the oxygen use in cells by the control group compared to oxygen use in cells of patients with mitochondrial myopathy.   *[1]*

    . . . . %

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(Question C1 continued)

(c) Discuss why people with mitochondrial myopathy tire more easily than healthy individuals. *[3]*

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C2. (a) State the name and function of

(i) a fibrous protein. . . . . *[1]*

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(ii) a globular protein. . . . . *[1]*

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(b) Annotate the graph representing an exergonic enzyme catalysed reaction. *[2]*
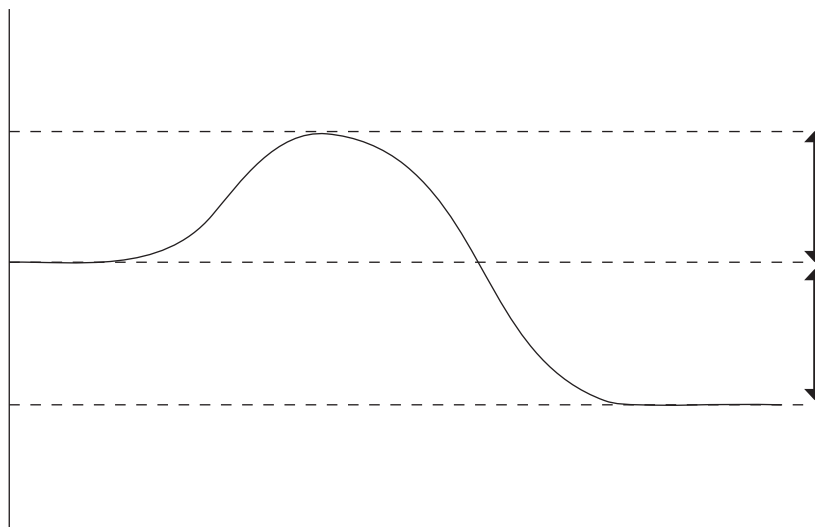
(c) Explain how end-product inhibition controls metabolic pathways. *[3]*

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C3. (a) Photosynthesis consists of two sets of reactions. State the names of these **two** sets.   *[1]*

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(b) Outline how **one** specific limiting factor affects the rate of photosynthesis.   *[2]*

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(c) Explain the production of ATP by chemiosmosis during photosynthesis.   *[3]*

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Option D — Evolution

D1. Ecologists investigated two species of beetle, *Carabus lewisianus* and *Carabus albrechti*, which live in neighbouring areas in a mountainous region of Honshu, Japan. They analysed the genetic composition of a mitochondrial protein, called a haplotype, from beetles caught in different parts of their range. The results are shown below with each pie chart representing the sample site location.
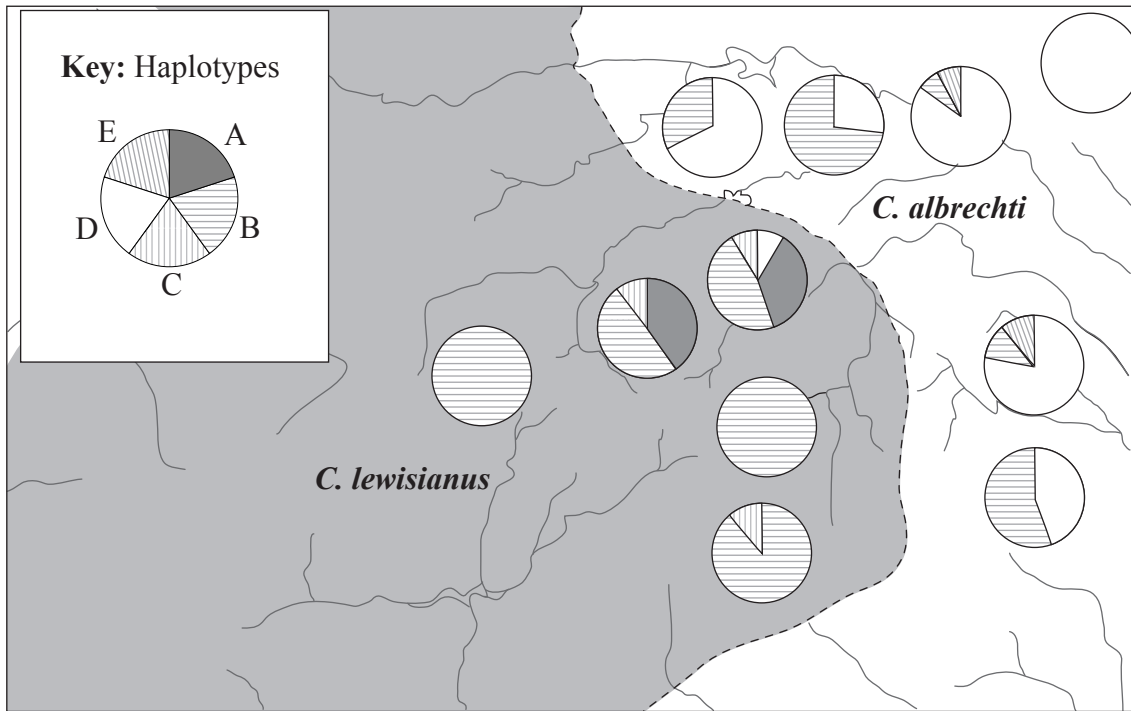
[Source: "Morphological, genetic and behavioural analyses of a hybrid zone between the ground beetles Carabus lewisianus and C. albrechti (Coleoptera, Carabidae): asymmetrical introgression caused by movement of the zone", Yasuoki Takami and Hirobumi Suzuki, *Biological Journal of the Linnean Society*, September 2005, vol. 86, issue 1, pages 79–94, Wiley-Blackwell. Used with permission.]

(a) State which haplotype is commonest in *C. albrechti*. *[1]*

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(b) Distinguish between the distribution of the haplotypes in the two species. *[2]*

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(Question D1 continued)

(c)   Explain the hypothesis that these two species shared a common ancestor.   *[3]*

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D2.   (a)   State the **two** substances that are thought to be responsible for polymerisation reactions during the pre-biotic phase of the origin of life on Earth.   *[1]*

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(b)   Outline the conditions that existed on pre-biotic Earth.   *[2]*

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(c)   Discuss the endosymbiotic theory.   *[3]*

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D3. (a) State how remains of past living organisms have been preserved. *[2]*

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(b) State **one** reason why the fossil record of many species is incomplete. *[1]*

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(c) Discuss the changes that have occurred during the evolution of humans from African apes. *[3]*

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**Option E — Neurobiology and Behaviour**

E1. Serotonin is a neurotransmitter that inhibits aggressive behaviour in animals. An experimental population of the lizard *Analis carolinensis* was observed to identify the most aggressive and least aggressive animals. The levels of serotonin in various parts of the brain of all the lizards was measured.

The bar chart below shows the whole population's mean serotonin value as 0 and the percentage variation found in the most agressive and least aggressive lizards.
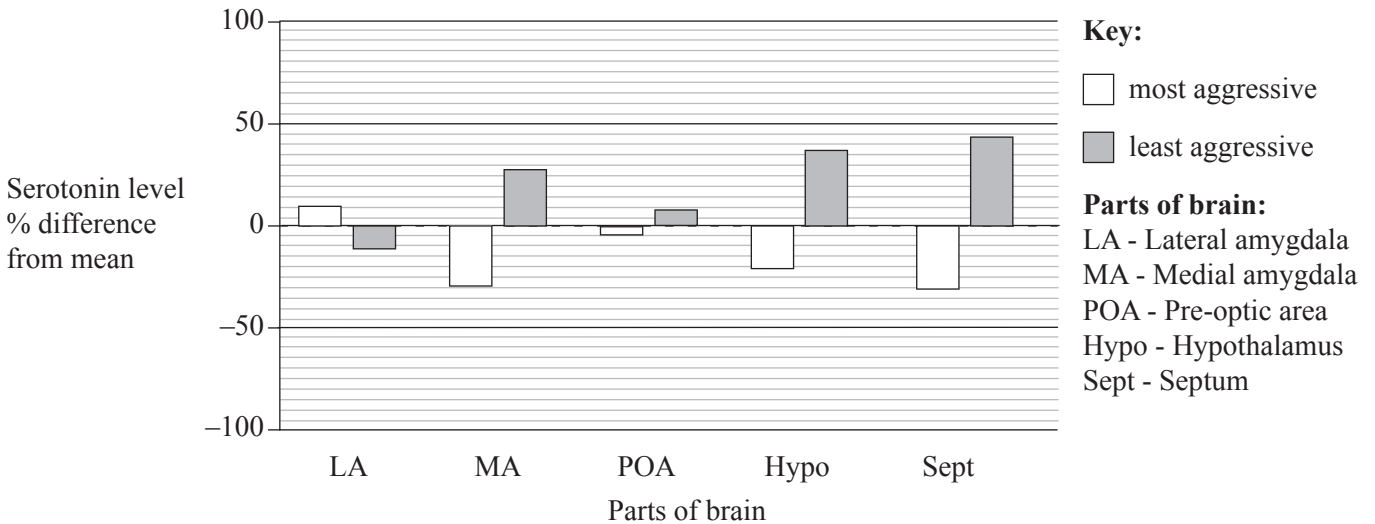
[Source: Cliff H Summers *et al*., 'Does Serotonin Influence Aggression? Comparing Regional Activity before and during Social Interaction', *Physiological and Biochemical Zoology*, 78 (5), pp. 679-694, Sep-Oct 2005. Copyright © 2008. University of Chicago Press.]

(a)   State which area of the brain appears to be **least** associated with serotonin production suppressing aggression.   *[1]*

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   . . . .

(b)   Calculate the percentage difference in serotonin production between the two groups of lizards in the septum.   *[1]*

   Answer: . . . .

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(Question E1 continued)

(c) Deduce the relationship between aggression in lizards and amounts of serotonin found in the brain. *[3]*

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E2. (a) Explain, with a **named** example, the following types of behaviour. *[3]*

Type of behaviour	Named example	Explanation
Communication		
Migration		
Grooming		

(b) Identify the parts labelled on the diagram of the human retina shown below. *[2]*
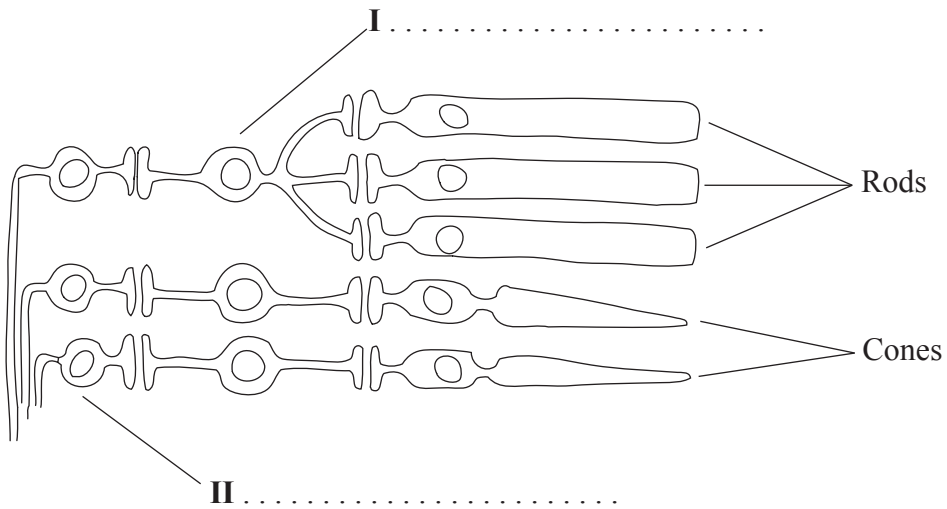
(c) State **two** differences between rod cells and cone cells in the human retina. *[2]*

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E3. (a) Define the term *innate behaviour*. *[1]*

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(b) Draw and label a diagram of the gross structure of the human brain. *[2]*

(c) Discuss the use of the pupil reflex as a test for brain death. *[3]*

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Option F — Applied Plant and Animal Science

F1. The mold *Penicillium expansum* causes serious crop loss of apples and pears during storage and packing. The graphs below show the density of *P. expansum* spores on normal skin, damaged skin and lenticels (small air pores allowing gaseous exchange) of apples. The experiments show the results at two humidity levels over a four day period.
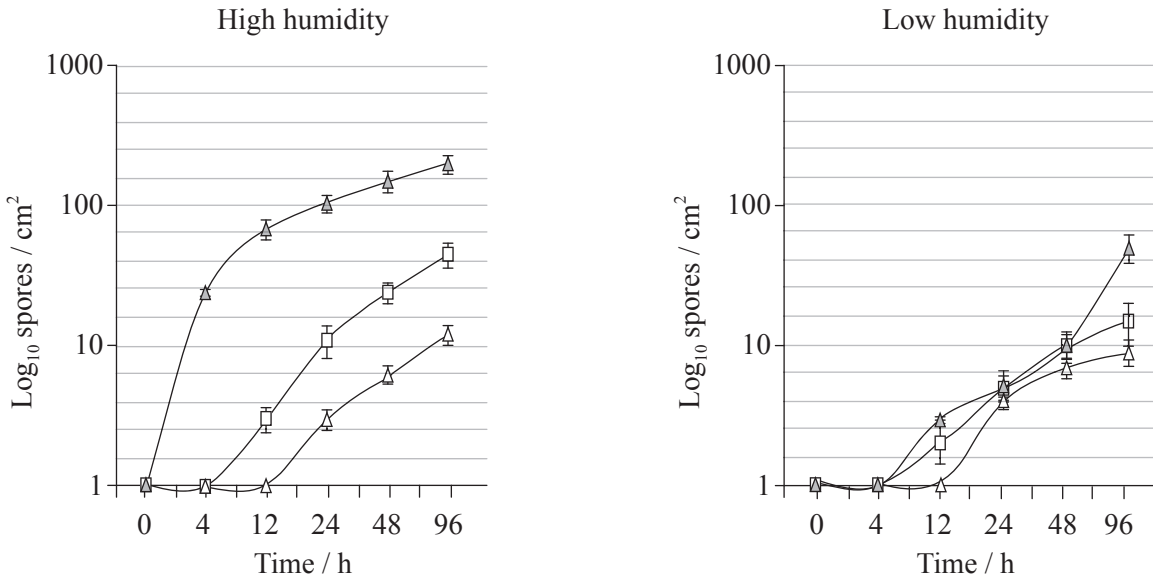
Key: △ density of spore on normal skin □ density of spores on damaged skin △ density of spore on lenticels

[Source: This article was published in *Physiological and Molecular Plant Pathology*, Volume 67, Issue 1, authors Achour Amiri, Danielle Cholodowski and Gilbert Bompeix, "Adhesion and germination of waterborne and airborne conidia of Penicillium expansum to apple and inert surfaces", pp. 40-48, copyright Elsevier (2005).]

(a) State the time taken for spores on the skin to reach a density of 100 spores/cm^2 at high humidity. *[1]*

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(b) Compare the density of spores on normal skin with spores on lenticels for apples stored at high humidity. *[2]*

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(This question continues on the following page)

(Question F1 continued)

(c)   Discuss whether apples should be stored at high humidity or low humidity.   *[3]*

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F2.   (a)   Complete the table by stating **named** examples of plants that are important to humans.   *[2]*

Importance to humans	Named example
Use in clothing	
Used as a fuel	
Building material	
Aesthetic or decorative use	

(b)   Outline how greenhouses can be used to improve plant productivity.   *[2]*

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(c)   Discuss the use of living organisms to control pest species.   *[3]*

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Turn over

F3. (a) State the technique used to produce bushy plants by removing apical dominance. *[1]*

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(b) Using **two** named examples describe how plant growth regulators are used to improve commercial production of crops. *[2]*
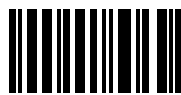
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(c) Explain how veterinary techniques have improved the fecundity of animals. *[2]*

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Option G — Ecology and Conservation

G1. Scientists examined the fauna found in the North Sea and measured the relative abundance of a number of species over a period of time at three locations. The depth of water at all the locations was similar although their distance to the coast varied. The North Sea is surrounded by densely populated and industrial European countries. The species were divided into four broad groups:

    I.   disturbance sensitive
    II.   disturbance indifferent
    III. disturbance tolerant
    IV.   opportunistic

The results are shown below. No measurements were taken in the months where there is no column.
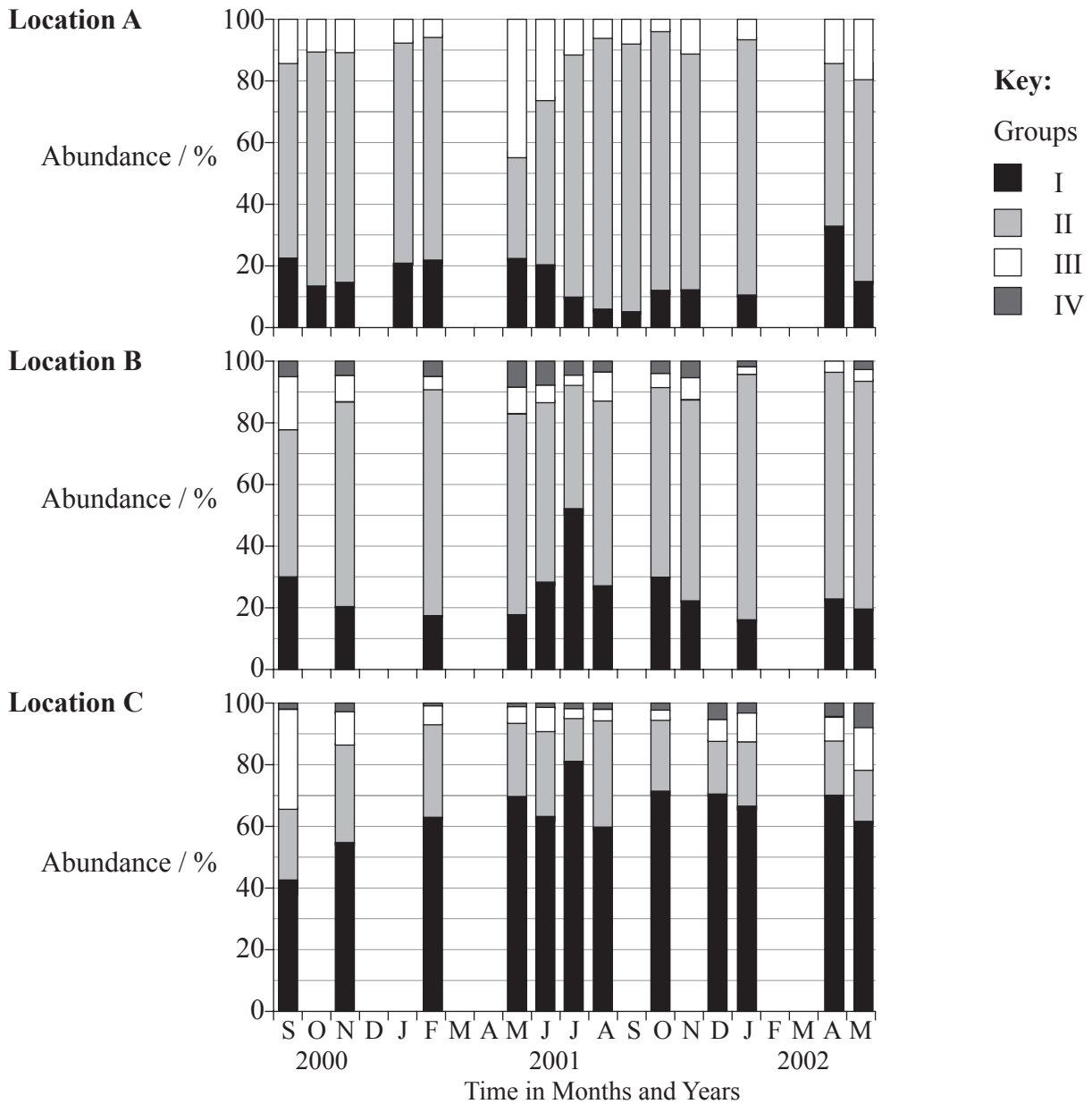
[Source: This article was published in Marine Pollution Bulletin, Vol. 50, Issue 12, authors Henning Reiss, Ingrid Kröncke, "Seasonal variability of benthic indices: an approach to test the applicability of different indices for ecosystem quality assessment", pp.1490-1499, copyright Elsevier (2005).]

(This question continues on the following page)

(Question G1 continued)

(a)   State the lowest relative abundance of disturbance sensitive species at location C.   *[1]*

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(b)   (i)   In location A, identify the months in which abundance levels are lowest and highest
            for disturbance indifferent species.   *[1]*

            Lowest: . . . .

            Highest: . . . .

       (ii)   Calculate the difference in the abundance levels for the answers in (b) (i).   *[1]*

            Answer: . . . .

(c)   Suggest, giving reasons, which location appears to be **least** affected by human activity
       over the experimental period.   *[3]*

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

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(b) Describe the interactions that occur between species by completing the table below.   *[2]*

Interaction	Description
Competition	
Parasitism	
Mutualism	
Herbivory	

(c) Explain how primary succession and secondary succession affects the abiotic environment.   *[3]*

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G3. (a) State the factors that have resulted in the extinction of one **named** plant species in recent historical times. *[1]*

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(b) Describe what the Simpson diversity index can tell ecologists about species and their environment. *[2]*

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(c) Discuss what measures could be taken to conserve fish stocks across the world. *[3]*

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