



22086018

**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.



**Option A — Diet and Human Nutrition**

**A1.** Most nutrition experts will agree that eating breakfast is an important factor for an individual’s nutritional well being. In North America, breakfast consumption is declining in all age groups. Of particular concern are young people who increasingly eat no breakfast.

The following table is part of a large investigation that considered the impact of breakfast consumption on the nutritional needs of children, adolescents and young adults. It shows the percentage of ten year-olds eating **less than** two thirds of the recommended daily allowances (RDA) of selected vitamins and minerals by their breakfast eating habits.

Nutrient	Percentage of ten year-olds eating less than two thirds of the RDA		
	Breakfast at Home	Breakfast at School	No Breakfast
Vitamin A	13	4	42
Vitamin B <sub>6</sub>	35	27	58
Vitamin B <sub>12</sub> (cyanocobalamin)	3	1	4
Vitamin D (calciferol)	55	24	88
Vitamin E	45	54	55
Riboflavin	7	2	32
Folic Acid	8	12	43
Thiamin	27	17	47
Niacin	21	27	30
Calcium	25	3	51
Phosphorus	4	2	12
Magnesium	10	2	27
Iron	28	29	42
Zinc	28	16	46

[Source: Theresa A. Nicklas *et al.*, ‘The Importance of Breakfast Consumption to Nutrition of Children , Adolescents and Young Adults’, *Nutrition Today*, (2004), **29**, pages 30-38, © Lippincott Williams & Wilkins, USA]

(a) Identify the nutrient for which the lowest percentage of ten year-olds are deficient. [1]

.....  
.....

*(This question continues on the following page)*



*(Question A1 continued)*

- (b) Compare the data for vitamin D (calciferol) in the three breakfast eating habits. [2]

.....  
.....  
.....  
.....

- (c) Using the data, discuss whether ten year-olds should be recommended to eat breakfast at home or at school. [2]

.....  
.....  
.....  
.....  
.....



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

.....  
.....

(b) (i) List **three** foods that are important sources of protein in human diets. [1]

1. ....
2. ....
3. ....

(ii) Outline how the products of protein digestion are used in the human body. [2]

.....  
.....  
.....  
.....

(c) Explain the importance of fibre in the diet. [2]

.....  
.....  
.....  
.....  
.....



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

.....  
.....

(b) Discuss whether a vegan diet is likely to result in rickets. [3]

.....  
.....  
.....  
.....  
.....  
.....

(c) Suggest how malnutrition can be caused by economic and environmental conditions. [3]

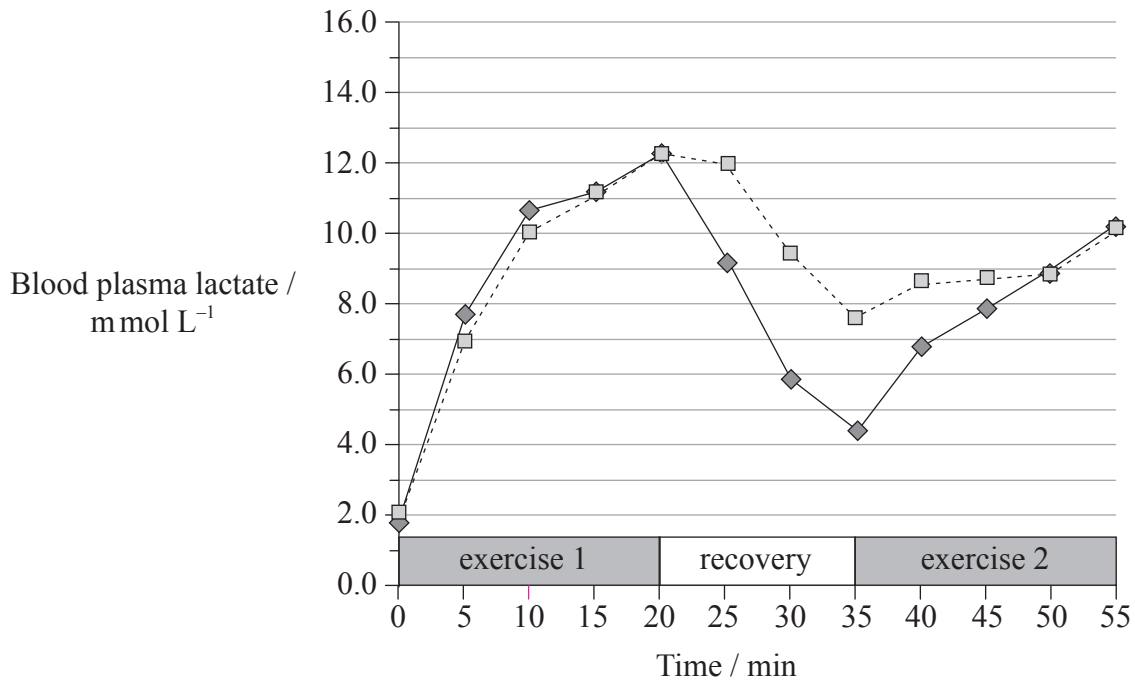
.....  
.....  
.....  
.....  
.....  
.....



**Option B — Physiology of Exercise**

**B1.** During intense aerobic exercise, lactate concentrations in blood plasma rise and eventually interfere with muscle performance. Some athletes routinely alternate between periods of intense aerobic exercise and periods of recovery while training. An investigation was conducted to determine the blood plasma lactate concentrations during the following sequence:

- exercise 1 – high intensity cycling
- recovery – active or passive
- exercise 2 – high intensity cycling.



**Key:** —◆— = active recovery (low-intensity cycling)  
 ---□--- = passive recovery (lying down)

[Source: Reprinted, with permission, from A.J. McAinch, M.A. Febbraio, J.M. Parkin, S. Zhao, K. Tangalakis, L. Stojanovska, and M.F. Carey, 2004, "Effect of Active Versus Passive Recovery on Metabolism and Performance During Subsequent Exercise", *International Journal of Sport Nutrition and Exercise Metabolism* 14(2):192.]

(a) Calculate the difference in the blood plasma lactate concentrations of active recovery and passive recovery at the end of the recovery period. [1]

.....  
 .....

(This question continues on the following page)



*(Question B1 continued)*

- (b) Compare how active recovery and passive recovery affect blood plasma lactate concentrations during the recovery period. [2]

.....

.....

.....

.....

.....

- (c) Evaluate the claim that active recovery is preferable to passive recovery based on the blood plasma lactate concentrations of exercise 2. [3]

.....

.....

.....

.....

.....

- (d) State the organ which breaks down blood plasma lactate after anaerobic exercise. [1]

.....



**B2.** (a) Explain the role of adrenaline in helping muscles contract. [2]

.....

.....

.....

.....

.....

(b) Compare the difference between slow (tonic) and fast (twitch) muscle fibres. [2]

Slow (tonic)	Fast (twitch)
.....	.....
.....	.....
.....	.....
.....	.....
.....	.....
.....	.....
.....	.....
.....	.....





**B3.** (a) In the space below draw and label the structure of a motor neuron. [3]

(b) Explain how the contraction of muscle is controlled. [4]

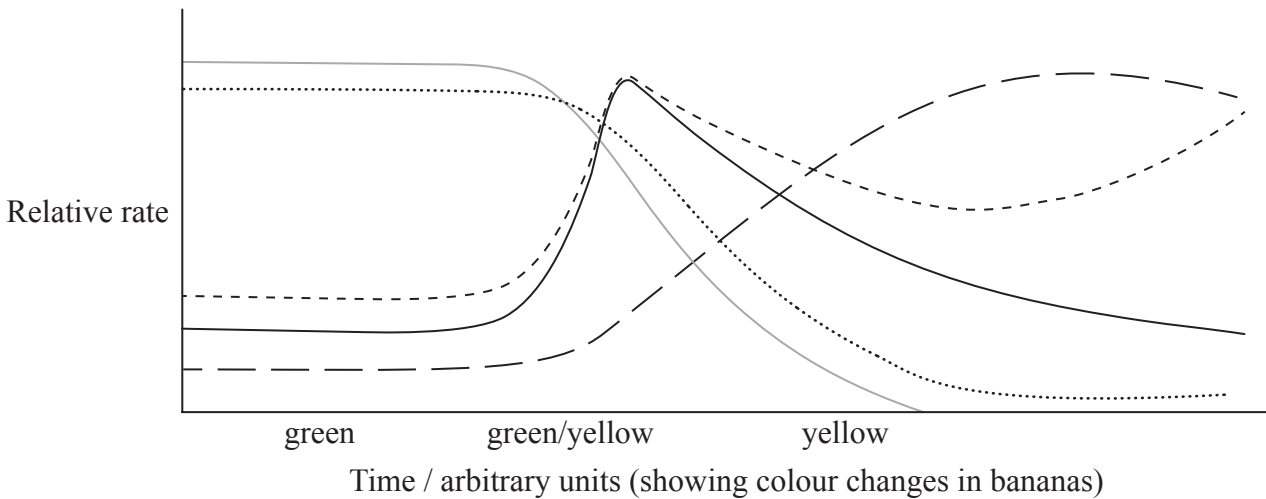
.....  
.....  
.....  
.....  
.....  
.....  
.....



**Option C — Cells and Energy**

**C1.** Fruits remain alive for a period of time after harvesting. Cellular respiration continues and it can greatly influence the maturation (ripening) process in the fruits. The rate of respiration depends on many factors such as the type, quality, degree of ripeness and water content of the fruits, temperature and air composition. Respiration that continues after harvesting may sometimes lead to the over-ripening and eventual loss of an entire cargo of fruit during transport.

Studies of the maturation process in bananas are summarized in the following graph.



- Key:**
- chlorophyll breakdown
  - ..... starch breakdown
  - water release
  - CO<sub>2</sub> formation
  - sugar formation

[Source: [www.containerhandbuch.de/chb\\_e/scha/index.html?chb\\_e/scha/scha\\_15\\_02\\_03\\_02.html](http://www.containerhandbuch.de/chb_e/scha/index.html?chb_e/scha/scha_15_02_03_02.html)]

- (a) (i) State **two** chemical products released as gases during cellular respiration. [1]
1. ....
  2. ....
- (ii) State **one** non-chemical product of respiration. [1]
- .....

*(This question continues on the following page)*



*(Question C1 continued)*

- (b) Using the data, analyse the events that occur when maturation begins in bananas. [2]

.....  
.....  
.....  
.....

- (c) Suggest, giving reasons, **two** ways in which transport conditions can be controlled to minimize over-ripening. [2]

.....  
.....  
.....  
.....



C2. (a) Compare the structure of a mitochondrion with a chloroplast. [3]

Mitochondrion	Chloroplast
.....	.....
.....	.....
.....	.....
.....	.....
.....	.....
.....	.....
.....	.....
.....	.....
.....	.....

(b) Explain the role of chemiosmosis in oxidative phosphorylation. [3]

.....

.....

.....

.....

.....



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

.....  
.....

(b) Draw and label the action spectrum of photosynthesis. [3]

(c) Explain the concept of limiting factors with reference to light intensity. [2]

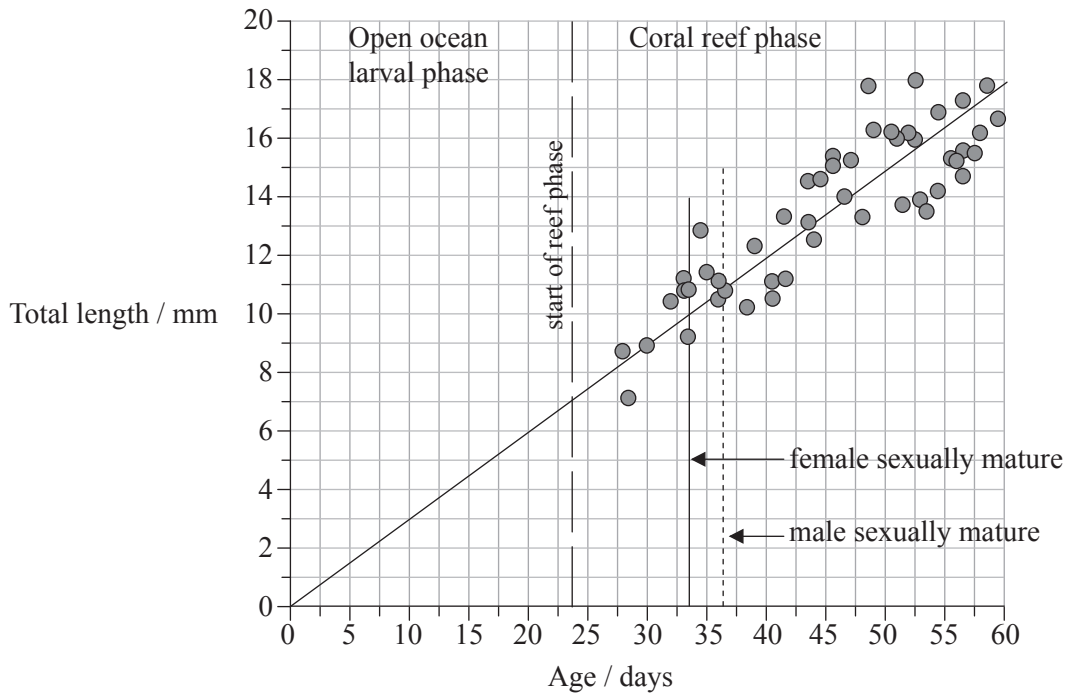
.....  
.....  
.....  
.....



**Option D — Evolution**

**D1.** Up to 40% of the fish living on coral reefs in the Indian and Pacific oceans are less than 10 cm in length as adults. The pygmy goby, *Eviota sigillata*, found on the Great Barrier Reef, Australia, was investigated because it has a small body size and the shortest lifespan (59 days) for any vertebrate. The study raised questions about the evolution of pygmy goby on coral reefs.

The following data provides details about the growth of pygmy gobies which start as an open ocean larval phase followed by a coral reef phase.



[Source: This article was published in *Current Biology*, Vol. 15, Issue 8, authors Martial Depczynski and David R Beellwood, "A vertebrate with the shortest recorded lifespan", pp. R288-R289, copyright Elsevier (2005).]

(a) State the relationship between age and size in pygmy gobies at ages 40 to 50 days. [1]

.....

(b) Analyse the data to determine the length of time during which a female pygmy goby can reproduce. [1]

.....  
.....

(This question continues on the following page)



*(Question D1 continued)*

- (c) Assuming that pygmy gobies reproduce throughout the year, estimate the **maximum** number of generations that could occur in one year. *[1]*

.....  
.....

- (d) Suggest why natural selection in pygmy gobies favours

- (i) small size. *[1]*

.....

- (ii) early sexual maturity. *[1]*

.....

- (iii) short-life span. *[1]*

.....



**D2.** (a) List **two** ways through which the remains from past living organisms have been preserved. [1]

1. ....

2. ....

(b) Using **one** example, explain how biochemical variations can be used as an evolutionary clock. [3]

.....  
.....  
.....  
.....  
.....

(c) Describe the evidence for evolution as shown by the geographical distribution of living organisms. [2]

.....  
.....  
.....  
.....  
.....





**D3.** (a) State the phylum and order for human beings. [1]

Phylum: .....

.....

Order: .....

.....

(b) Distinguish between genetic evolution and cultural evolution. [2]

.....

.....

.....

.....

.....

(c) Discuss the relative importance of genetic evolution and cultural evolution in the evolution of humans. [3]

.....

.....

.....

.....

.....

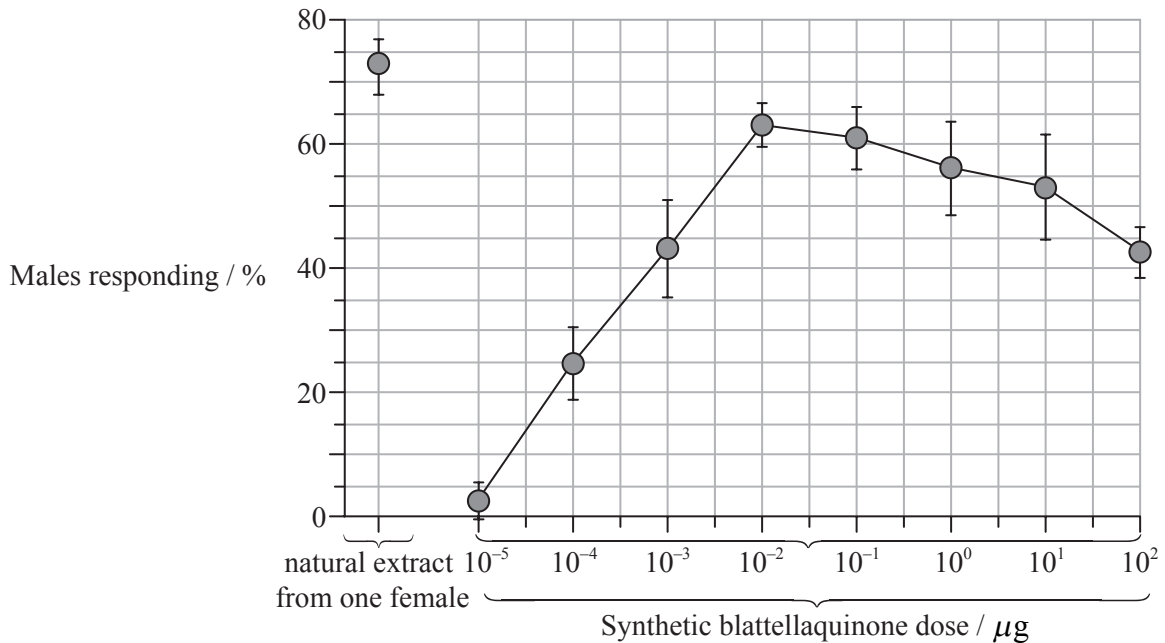
.....



**Option E — Neurobiology and Behaviour**

**E1.** The German cockroach (*Blattella germanica*) is one of the most important residential and food-associated pests worldwide. Control of cockroaches currently relies on applications of broad-spectrum insecticides. Scientists have recently isolated and chemically identified the sex pheromone produced by females to attract males. The pheromone, named blattellaquinone, has also been successfully prepared synthetically. Male cockroaches respond by running towards the sex pheromone.

The following data shows the percentage of male cockroaches responding to the crude extract of one female equivalent compared to various doses of synthetic blattellaquinone.



[Source: From Satoshi Nojima et al., 'Identification of the Sex Pheromone of the German Cockroach, *Blattella germanica*', *Science*, (2005), vol. 307, issue 5712, pages 1104-1106. Reprinted with permission from AAAS.]

(a) Identify the most effective sex attractant. [1]

.....

(b) Using the data, describe the effect of synthetic blattellaquinone on the male cockroach behaviour. [3]

.....  
.....  
.....  
.....  
.....

(This question continues on the following page)



*(Question E1 continued)*

- (c) Deduce whether the behaviour of the male cockroach in response to the sex pheromones is a taxis or kinesis. Give **one** reason for your answer. [1]

.....  
.....

- (d) State the type of receptor used by male cockroaches to detect the sex pheromones. [1]

.....  
.....

- (e) Design a method for using blattellaquinone to control cockroaches. [2]

.....  
.....  
.....  
.....  
.....



**E2.** (a) Draw and label the structure of the human eye.

[2]

(b) Distinguish between rods and cones.

[2]

.....  
.....  
.....  
.....



**E3.** (a) Explain how natural selection affects the development of behaviour. [2]

.....  
.....  
.....  
.....

(b) Define the term *operant conditioning*. [1]

.....  
.....

(c) List **three** examples of animals that show social behaviour. [1]

.....

(d) Discuss how learning improves the chances of survival. [2]

.....  
.....  
.....  
.....



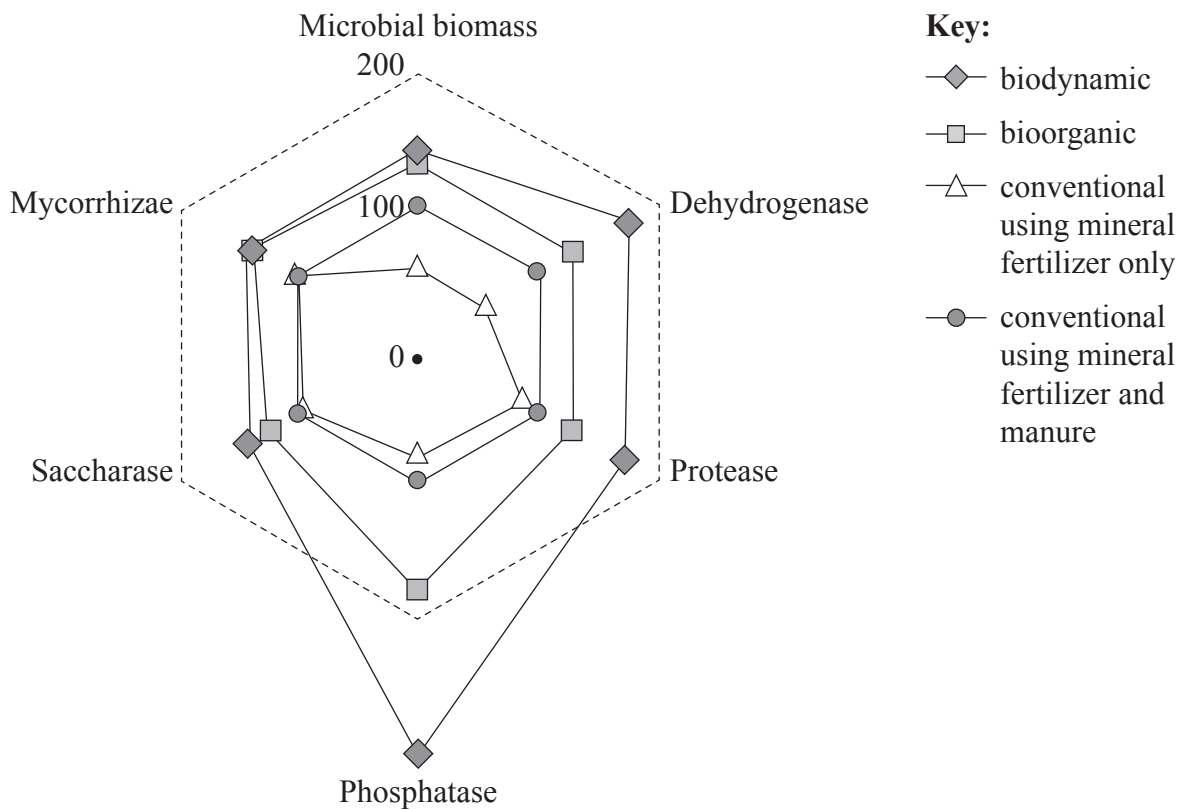
**Option F — Applied Plant and Animal Science**

**F1.** Recently, a twenty-one year study was completed in Europe to determine the effectiveness of four different farming methods. Two organic methods, biodynamic and bioorganic, and two conventional methods, one using mineral fertilizer only and one using mineral fertilizer and manure, were all compared. The study considered how these four methods affected the physical, chemical, microbial and faunal (animal life) properties of the soil. In the following radial graph, microbial results are presented relative to the conventional method using mineral fertilizer and manure set at 100%.

*Definitions:*

Mycorrhizae are associations between roots and fungi that can help roots absorb water and minerals from the soil better than roots without a fungus partner.

Dehydrogenase, protease, phosphatase, and saccharase are enzymes in soil microorganisms which contribute to nutrient recycling.



[Source: From Paul Maeder *et al.*, 'Soil Fertility and Biodiversity in Organic Farming', *Science*, May 2002, vol. 296, issue 5523, pages 1694-1697. Reprinted with permission from AAAS.]

*(This question continues on the following page)*



*(Question F1 continued)*

(a) (i) Identify which enzyme appeared to be **most** affected by the different farming methods. [1]

.....

(ii) Identify which enzyme appeared to be **least** affected by the different farming methods. [1]

.....

(b) List the farming methods from the lowest to the highest in their effect on microbial biomass. [2]

.....  
.....  
.....  
.....

(c) Evaluate the claim that organic farming methods are better for soil properties than conventional methods. [2]

.....  
.....  
.....  
.....



**F2.** (a) State **one** example of a plant used in each of the following categories. [2]

(i) Fuel .....

(ii) Clothing .....

(iii) Building material .....

(iv) Aesthetic value .....

(b) Define the term *net assimilation rate*. [1]

.....  
.....

(c) Describe the role of auxins in phototropism. [2]

.....  
.....  
.....  
.....

(d) Explain how plant productivity can be optimized by greenhouses. [2]

.....  
.....  
.....  
.....





**F3.** (a) State **three** purposes for which animals have been domesticated. [1]

- 1. ....
- 2. ....
- 3. ....

(b) Explain how **two** different veterinary techniques have been used to benefit livestock health and production. [4]

.....

.....

.....

.....

.....

.....

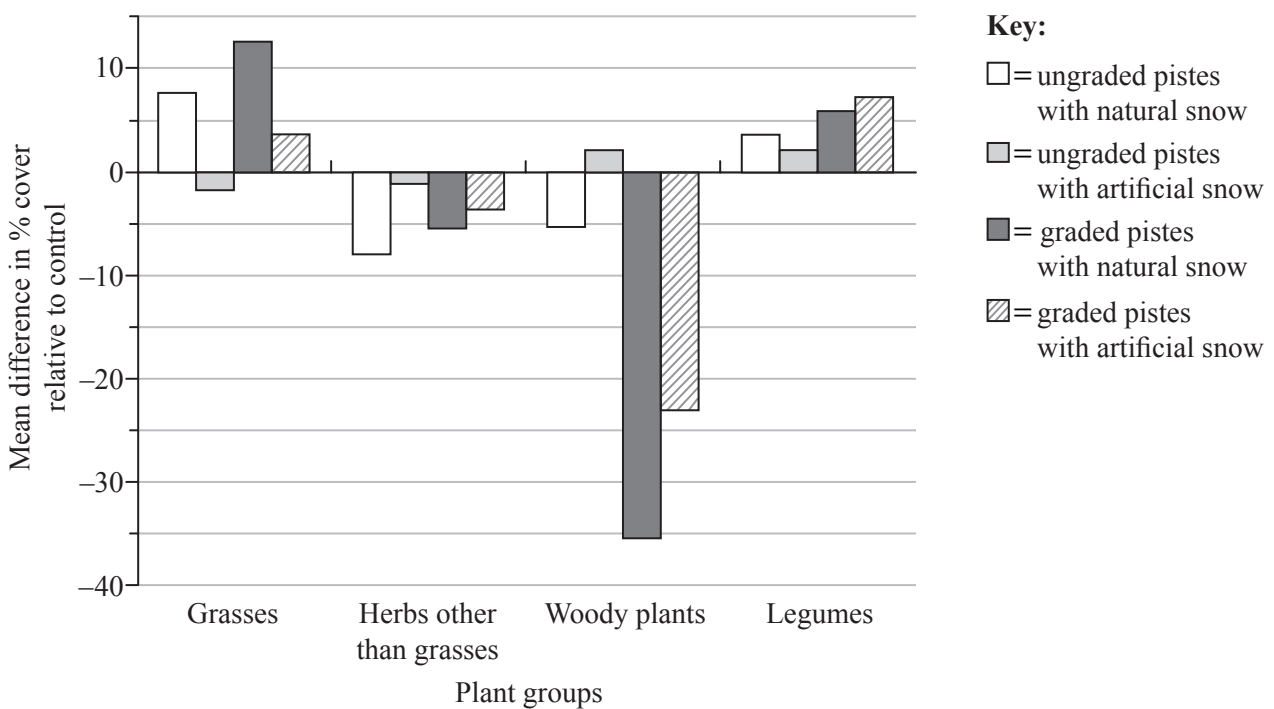
.....



**Option G — Ecology and Conservation**

**G1.** Downhill skiing is important economically to the alpine regions of Europe. Ski trails (pistes) are being enlarged, their sloping surfaces are being graded (made smooth with machines) and the use of artificial snow is increasing. Alpine habitats normally range from areas of vegetation with rich species diversity to extreme regions where only a few species can survive. Plant communities are often characterized by their proportions of plant groups. Habitat disturbances can alter species composition, diversity and productivity, which may affect ecosystem functioning and stability.

The effects of ski piste preparation on alpine vegetation were studied. The following data shows the differences in species composition between ski pistes and a nearby undisturbed area (the control).



[Source: Sonja Wipf et al., 'Effects of ski piste preparation on alpine vegetation', *Journal of Applied Ecology* (April 2005), 42 (2), pages 306–316, Wiley-Blackwell. Used with permission]

(a) State **one** reason for the changes shown for ungraded ski pistes with natural snow relative to the control.

[1]

.....  
.....

(This question continues on the following page)



*(Question G1 continued)*

(b) (i) Identify which type of ski piste preparation caused the least overall impact on vegetation. [1]

.....

(ii) Identify which plant group is negatively affected by all four types of preparation. [1]

.....

(c) Analyse the effects of grading ski pistes on alpine vegetation. [2]

.....  
.....  
.....  
.....

(d) It is hypothesized that use of artificial snow (derived from nearby lakes, rivers or ground water) will promote growth of vegetation.

(i) Suggest a reason for this hypothesis. [1]

.....  
.....

(ii) Deduce, giving a reason, whether the data supports this hypothesis. [1]

.....  
.....



**G2.** (a) List **five** factors that affect the distribution of plant species. [1]

- 1. ....
- 2. ....
- 3. ....
- 4. ....
- 5. ....

(b) Explain the principle of competitive exclusion. [2]

.....  
.....  
.....  
.....

(c) Distinguish between predation and parasitism, giving **one** example of each. [2]

.....  
.....  
.....  
.....

**G3.** (a) Outline how the Simpson diversity index might be used in the management of natural reserves. [2]

.....  
.....  
.....  
.....

(b) Discuss reasons for *in situ* conservation of endangered species. [4]

.....  
.....  
.....  
.....  
.....  
.....  
.....  
.....

