



22066018

BIOLOGY
STANDARD LEVEL
PAPER 3

Friday 5 May 2006 (morning)

1 hour

Candidate session number

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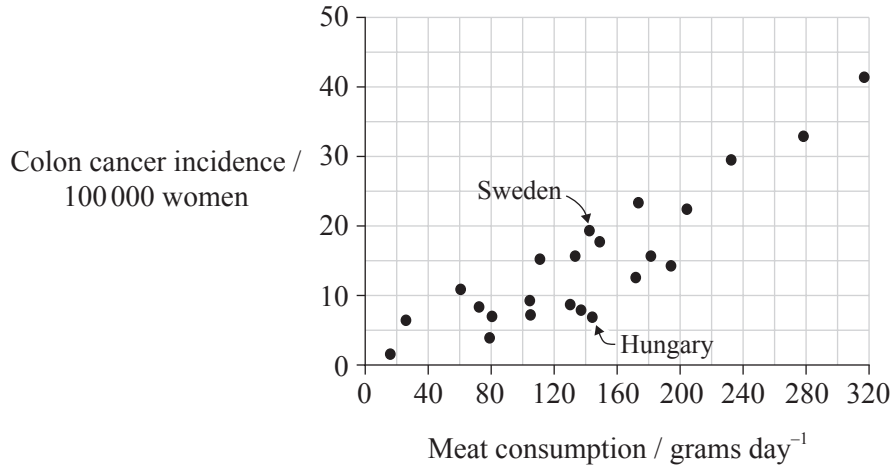
INSTRUCTIONS TO CANDIDATES

- Write your session number in the boxes above.
- Do not open this examination paper until instructed to do so.
- 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 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.

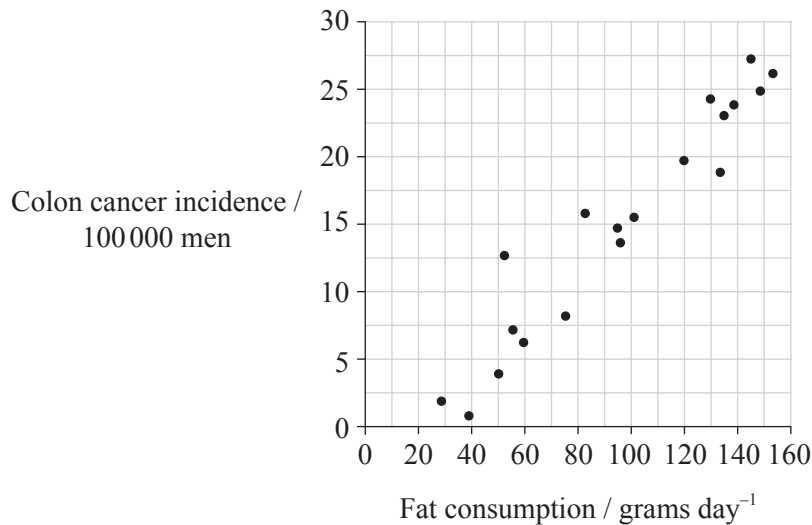


Option A — Diet and Human Nutrition

A1. Dietary factors are known to influence the incidence of colon cancer. The graphs below show the correlation between meat consumption (eating meat) and colon cancer in sample countries and the correlation between fat consumption and colon cancer.



[Source: B Armstrong and R Doll, *Environmental factors and cancer incidence and mortality in different countries, with special reference to dietary practices*, (1975), *International J Cancer*, **15**, pp 617–631]



[Source: <http://members.aol.com/wantnomeat/page>]

(This question continues on the following page)



(Question A1 continued)

- (a) (i) State the relationship between daily meat consumption and the incidence of colon cancer in women. [1]

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- (ii) Using the data in the two graphs opposite, suggest reasons for the relationship between daily meat consumption and the incidence of colon cancer in women. [2]

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- (b) (i) Calculate the difference in colon cancer incidence between Hungarian women and Swedish women. [1]

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- (ii) Discuss whether meat consumption causes colon cancer in Sweden and Hungary. [3]

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A2. Packaged food items are labelled with the amounts of nutrients that the food contains.

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

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(b) State **one** other type of dietary information that is included on food labels. [1]

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(c) Food labels sometimes also provide instructions for how the food should be handled and prepared to prevent food poisoning. Suggest **two** instructions that could be given to help prevent food poisoning. [2]

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A3. (a) Explain briefly what vitamins are, and why they are important in the diet. [3]

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(b) State the function of tocopherol (vitamin E) in the human body. [1]

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(c) A vegan diet includes no animal products such as meat, milk or honey. Discuss the possibility of vitamin deficiencies with a vegan diet. [3]

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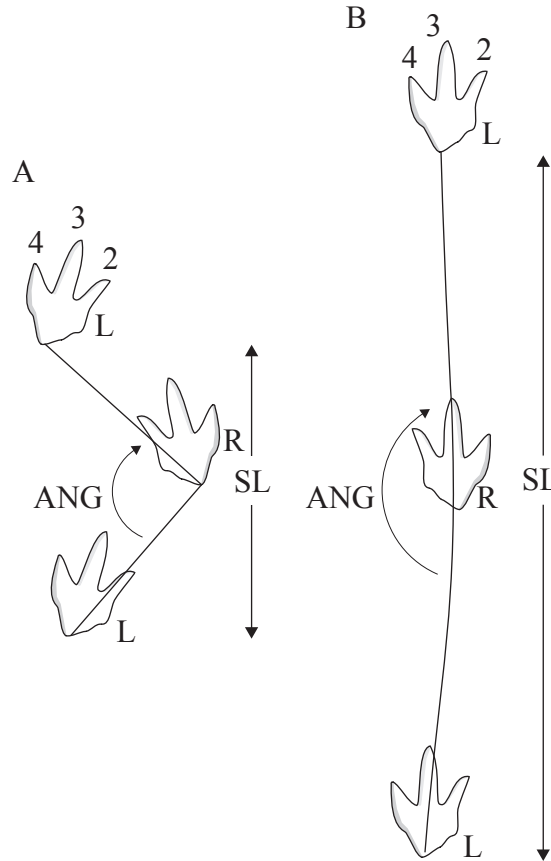
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Option B — Physiology of Exercise

B1. At Ardley Quarry near Oxford in England, a large number of tracks made by a theropod dinosaur 163 million years ago have been preserved. The dinosaur used only its hind limbs for locomotion. Two types of track have been found and are represented in the diagrams below, left footprints labelled L and right footprints labelled R. The tracks have been analysed by measuring two parameters:

- stride length, shown as SL
- pace angle, shown as ANG.



[Reprinted by permission from Macmillan Publishers Ltd: Nature, Figure from Day et al. 'Biomechanics: Dinosaur locomotion from a new trackway', 415, pp 494–495 (31 January 2002), copyright (2002)]

(a) Explain which type of track the dinosaur made when it was running. Give a reason for your answer. [2]

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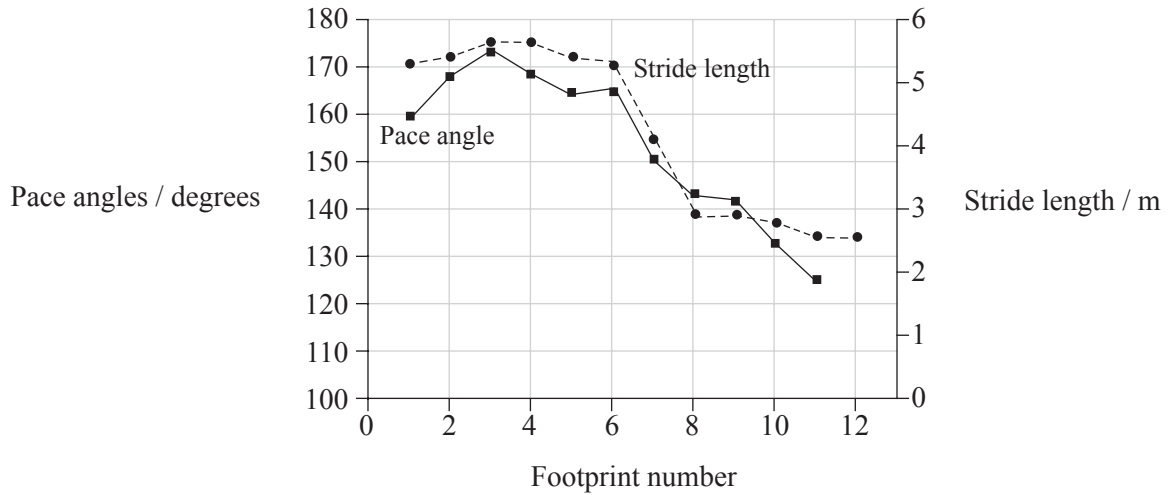
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(Question B1 continued)

One track is unique because it shows that the dinosaur changed its speed of locomotion. The graph below shows the pace angle and stride length of the twelve footprints in this track.



[Reprinted by permission from Macmillan Publishers Ltd: Nature, Figure from Day et al. 'Biomechanics: Dinosaur locomotion from a new trackway' 415, pp 494-495 (31 January 2002), copyright (2002)]

(b) State the maximum stride length of the dinosaur. [1]

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(c) (i) Deduce, with a reason, whether the dinosaur increased or decreased its speed of locomotion between footprints 3 and 11. [1]

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(ii) State the relationship shown in the graph between pace angle and stride length. [1]

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(iii) Suggest reasons for the relationship. [2]

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B2. Many different types of training programmes have been developed to improve performance in sport.

(a) Outline the principle of *specificity* in relation to training programmes. [1]

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(b) In some training programmes the intensity is gradually increased so that it is always greater than the muscles can easily endure. State the name given to this principle of training. [1]

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(c) Frequency, intensity and duration are three of the principles of training. Explain which **two** of these should be maximized during training for long distance running events. [2]

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(d) Training sometimes causes soft tissue injuries. Rest and elevation are used in the treatment of soft tissue injuries. State **one** other technique, which would help to reduce inflammation. [1]

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B3. (a) Explain how the vigorous use of muscles during exercise causes the ventilation rate to increase. [3]

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(b) Outline the structure of long bones, such as the humerus. [3]

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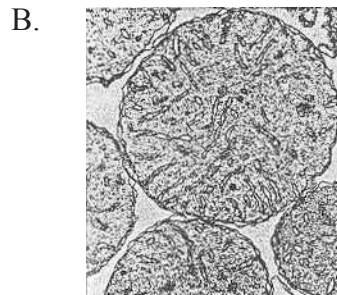
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Option C — Cells and Energy

C1. The electron micrographs below show mitochondria in longitudinal section. The mitochondrion in A is from a bat pancreas cell and that in B is from a mouse liver cell.



[Source: Tribe and Whittaker, *Chloroplasts and Mitochondria*, (1972), **31**, pp 28–29]

(a) Annotate the micrographs to show **two** similarities in the structure of the mitochondria. [2]

(b) The mitochondria differ in size. State **two** other differences that are visible in the mitochondria. [2]

1.

2.

(c) Predict, with **two** reasons, which of the mitochondria would have been able to produce ATP at a greater rate. [3]

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C2. Enzymes are globular proteins that act as biological catalysts.

(a) State **one** example of a globular protein, apart from enzymes. [1]

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(b) Outline where in a water-soluble protein the polar and non-polar amino acids are located. [2]

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(c) Explain briefly the effect that enzymes have on the activation energy of the reactions that they catalyse. [2]

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C3. Photosynthesis consists of light-dependent and light-independent reactions.

(a) Describe the light-independent reactions. [4]

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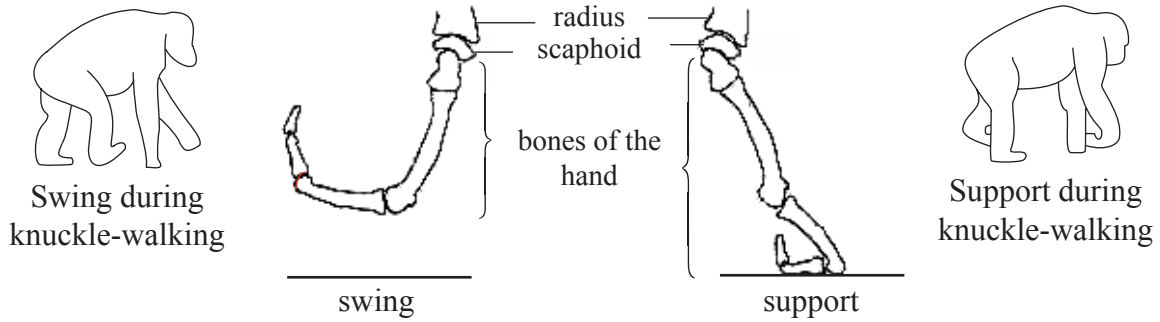
(b) Light intensity does not affect the light-independent reactions directly. State **two** external limiting factors that affect the light-independent reactions directly. [2]

- 1.
- 2.



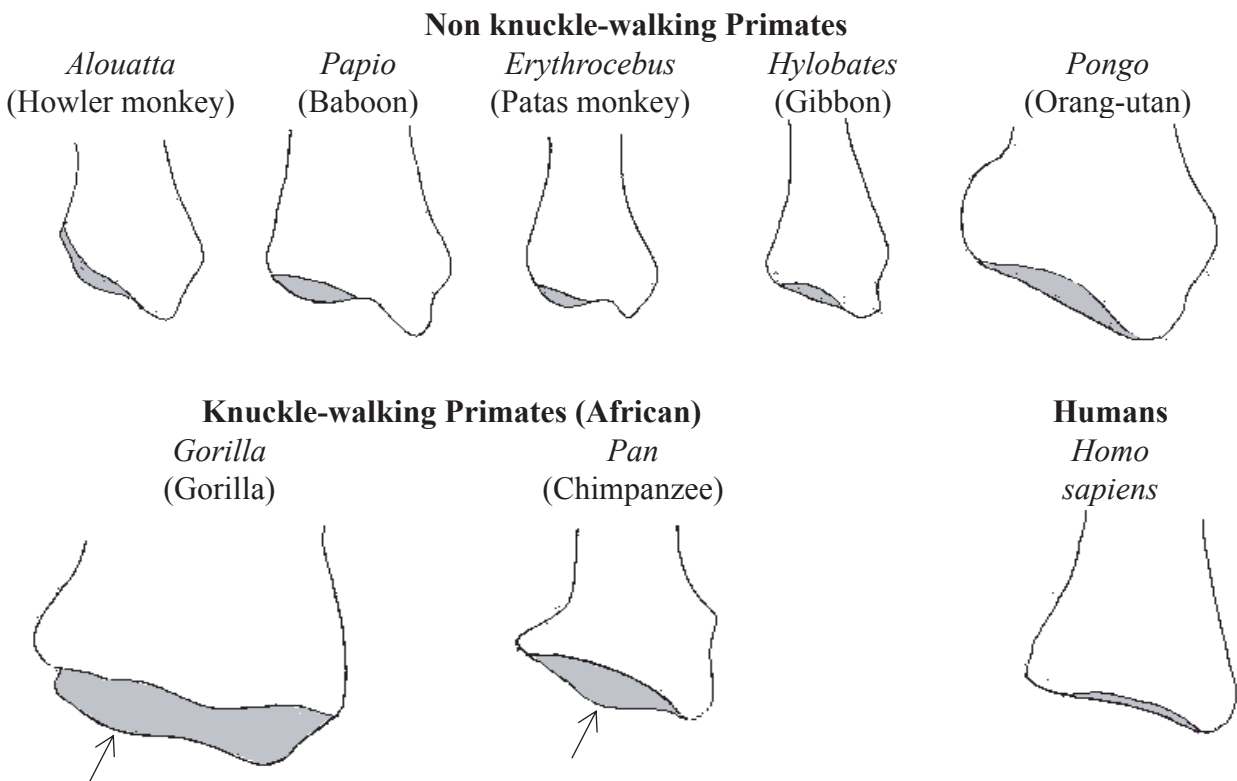
Option D — Evolution

D1. Some primates are adapted both to tree life and bipedal locomotion, using a method called knuckle-walking. The drawings below show two phases in knuckle-walking and the position of bones. In all primates the radius is connected to the scaphoid at the wrist. The radius has a concave region where this occurs, as shown in the diagrams below. In knuckle-walking these two bones can lock together, allowing the joint to support the primate’s weight.



[Reprinted by permission from Macmillan Publishers Ltd: Nature, diagram from: Richmond and Strait ‘Evidence that humans evolved from a knuckle walking ancestor’, 404, pp 382–385, (23 March 2000), copyright (2000)]

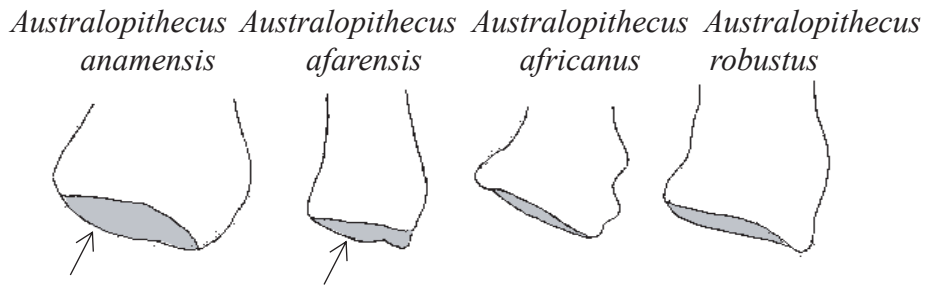
The drawings below show the shape of part of the radius including the concave region, in eight living and four extinct primates. The arrows show the position of a feature called the medial dorsal ridge which is present in four of these primates. This ridge is on one edge of the concave region.



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(Question D1 continued)

Fossils of *Australopithecus* (African)



[Source: Richmond and Strait, *Nature*, (2000), 404, pp 382–385]

- (a) Compare the concave region of the radius bones of the knuckle-walking primates with the same region in the non-knuckle-walking primates. [2]

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- (b) (i) Deduce, with reasons, which species of *Australopithecus* were knuckle-walkers. [2]

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- (ii) The drawings of the fossil *Australopithecus* radius bones are arranged according to their age, with *A. anamensis* the oldest and *A. robustus* the youngest. Explain the conclusions that can be drawn about the evolution of bipedalism from the data that you have been given. [3]

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D2. (a) Outline Lamarck's theory of evolution. [3]

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(b) Suggest **two** reasons for most biologists not accepting Lamarck's theory. [2]

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2.
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D3. DNA research has provided much useful evidence for evolution.

(a) Outline **one** conclusion from the discovery that all organisms use the same genetic code. [1]

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(b) The base sequence of specific genes has been found in many different species, for example the gene for cytochrome c. Differences in base sequence are often found even within a closely related group of species.

Discuss the conclusions that can be drawn from these differences in base sequence. [3]

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(c) Scientists who study the origin of life have suggested that the earliest organisms did not use DNA as their genetic material.

(i) State the substance that these organisms could have used instead. [1]

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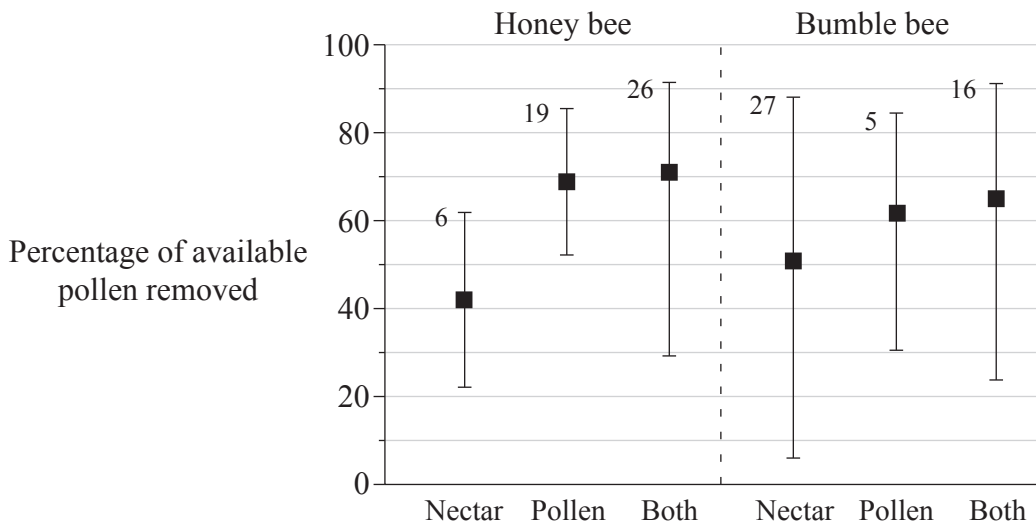
(ii) Suggest a reason for this theory. [1]

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Option E — Neurobiology and Behaviour

E1. Honey bees (*Apis sp.*) and bumble bees (*Bombus sp.*) both visit apple flowers. The behaviour of the bees during these visits shows whether the purpose of the visit is to collect nectar, or pollen or both. Scientists observed bees visiting apple flowers and recorded how many visits were made for each purpose. They also measured how much of the available pollen was removed from each flower during visits by the bees. The results are shown as a percentage in the chart below. The mean percentage is shown by the squares (■). The vertical line represents two standard deviations above and below the mean. The numbers of visits are shown above the vertical lines.



[Source: Thomson and Goodell, (2001), *Journal of Applied Ecology*, 38, pp 1032–1044]

(a) Compare the amount of pollen removed by the honey bees on the **three** types of visit to the apple flowers. [2]

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(b) Compare the **mean** amounts of pollen removed by honey bees with the **mean** amounts removed by bumble bees. [2]

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(Question E1 continued)

- (c) Evaluate the **numbers** of visits to the apple flowers to find the relative importance of pollen and nectar to the honey bees and bumble bees in the study. [3]

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E2. The pupil reflex is an example of a cranial reflex (a reflex controlled by the brain).

- (a) (i) State **one** other cranial reflex. [1]

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- (ii) Identify **one** sensory receptor in the cranial reflex named in (i). [1]

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- (iii) Outline the role of the effector(s) in this reflex. [2]

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- (b) Discuss the importance of innate behaviour, such as reflexes, in the survival of animals. [3]

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E3. (a) (i) State **one** species in which migration occurs. [1]

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(ii) Outline the migration route followed by this species. [1]

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(b) Explain the role of grooming behaviour in a **named** species. [2]

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Option F — Applied Plant and Animal Science

F1. Intensive chicken production involves the use of large houses and high stocking densities. Stocking density is expressed in kg m^{-2} and is measured as mean weight \times number of birds per area of house. To investigate the effects of stocking density, scientists conducted a large-scale study of chicken rearing at five different densities. The chicken’s ability to walk (gait score) was assessed on a scale of 0 to 2. A chicken with a score of 0 walks with ease, has regular and even strides and is well balanced. A chicken with a score of 2 is reluctant to move and is unable to walk many strides before sitting down. The frequency with which the chickens knocked against or pushed each other per minute was measured as the jostle rate. The growth rate of the chickens was also measured. The table below shows results of the study.

	Stocking density (kg m^{-2})				
	30	34	38	42	46
Percentage of chickens with gait score 0	80.8	74.2	76.1	68.0	61.1
Jostle rate (incidents per minute)	0.316	0.431	0.455	0.566	0.618
Growth rate (g day^{-1})	50.3	49.9	49.7	48.8	47.7

[Reprinted by permission from Macmillan Publishers Ltd: Nature, Table from: Dawkins et al. Chicken welfare is influenced more by housing conditions than by stocking density’ 427, pp 342–344, (22 January 2004), copyright (2004)]

(a) Evaluate the effect of stocking density in terms of

(i) ethical issues.

[3]

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(ii) yield.

[2]

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(Question F1 continued)

(b) The mortality rate of the chickens at the highest stocking density (46 kg m^{-2}) varied from 3 % to 9 % between different production companies. Suggest **two** reasons for the variation in mortality rate. [2]

- 1.
- 2.

F2. (a) State the name of **one** crop plant that is used to provide

(i) material for making clothes. [1]
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(ii) material for buildings. [1]
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(b) Crops are also grown to provide food. Some food crops are produced by a technique called hydroponics. Outline how crops are grown using hydroponics. [3]

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F3. (a) Distinguish between plant growth regulators and fertilizers. [2]

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(b) Explain the role of **one named** plant growth regulator in apical dominance. [2]

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(c) Describe **one** method for killing weeds using a plant growth regulator. [2]

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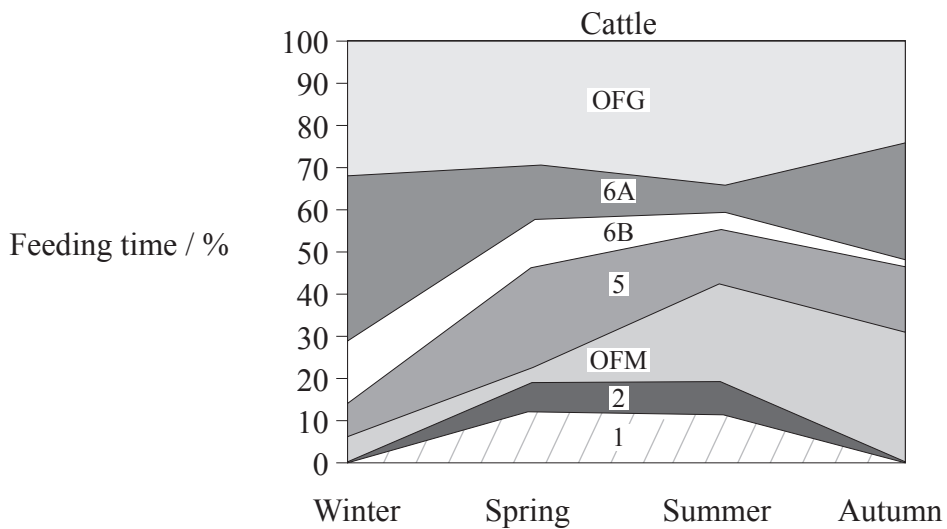
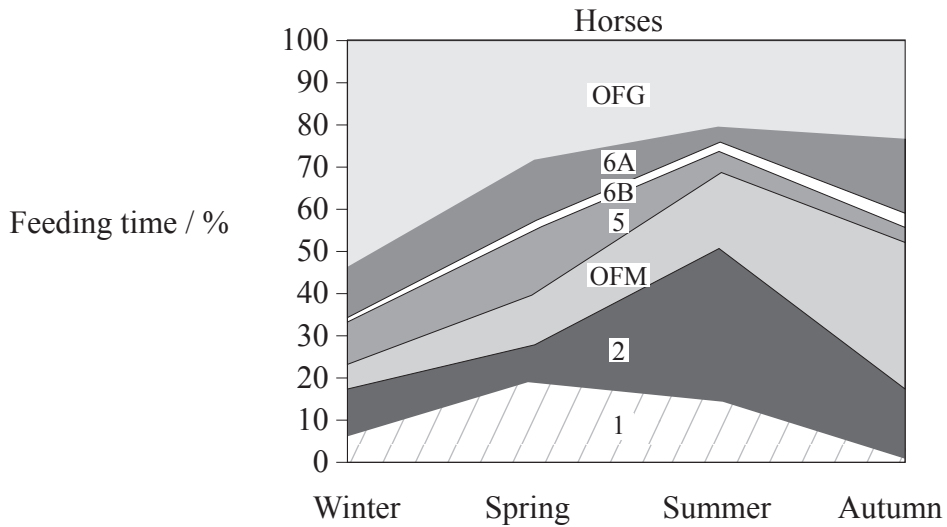


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Option G — Ecology and Conservation

G1. A study was conducted to determine whether horses and cattle have different ecological niches. The area used was part of the Carmargue, the delta of the Rhone River, in southern France where horses and cattle graze together. There were different habitat types within the area and these were classified (1, 2, OFM, 5, 6B, 6A and OFG). The charts below show the percentage of feeding time spent by the cattle and horses in these habitat types at different times of year. The table opposite shows the classification of habitat types.



[Source: Menard *et al.*, (2002), *Journal of Applied Ecology*, 39, pp 120–133]

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(Question G1 continued)

Habitat type	Description of habitat	Percentage of area
OFG	Grassland formed by ecological succession from old fields	6.1
6A	Coarse grassland with shrubs	9.3
6B	Grassland with salt tolerant plants	15.0
5	Upper salt flats with salt tolerant woody plants and herbs	41.9
OFM	Marshes artificially flooded from October to June	22.6
2	Marshes naturally flooded for two to six months in winter and spring	7.2
1	Marshes naturally flooded for nine to twelve months	7.5

(a) State which of the seven habitat types was used least for grazing by the horses. [1]

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(b) Compare the percentage of the time spent by horses grazing in the marshes between summer and winter. [1]

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(c) Analyse the data to find out if there is a positive correlation between the percentage of the area of each habitat type and the percentage of time spent feeding in it by horses. [2]

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(d) Evaluate the data to find whether cattle and horses in the Camargue have identical ecological niches, overlapping ecological niches or entirely separate ecological niches. [2]

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G2. Ecologists use two different measures of production in ecosystems: gross production and net production.

(a) Distinguish between gross production and net production. [2]

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(b) Estimate, with a reason, the net production of primary consumers (herbivores) in an ecosystem if the gross production of the primary consumers is $84 \text{ kJ m}^{-2} \text{ year}^{-1}$. [2]

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(c) Explain the reasons for a small biomass of organisms in the higher trophic levels of ecosystems. [3]

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G3. (a) Outline **three** reasons for conserving rainforests. [3]

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(b) Suggest reasons for removing alien species from natural ecosystems. [2]

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