



**BIOLOGY**  
**STANDARD LEVEL**  
**PAPER 3**

Tuesday 22 May 2001 (morning)

1 hour 15 minutes

Name

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Number

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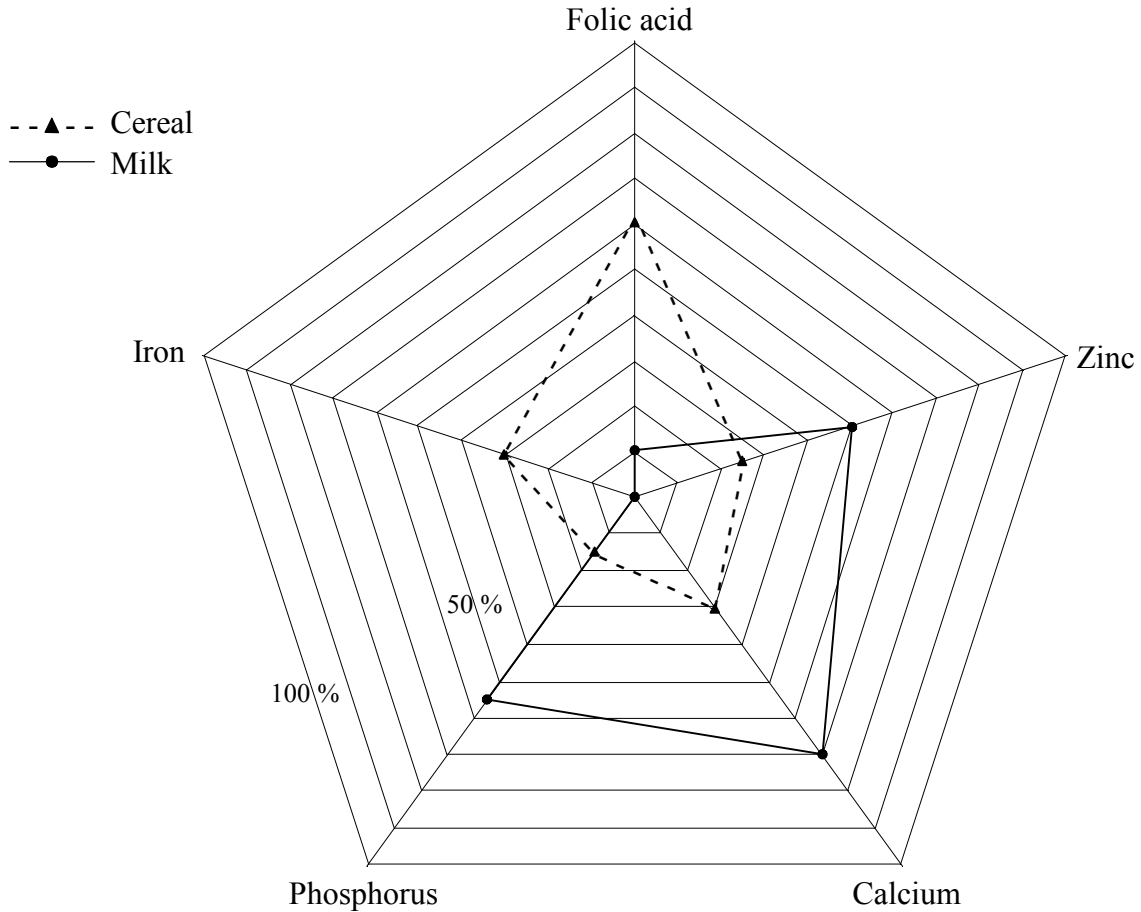
**INSTRUCTIONS TO CANDIDATES**

- 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 three 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
	/15	/15	/15
	/15	/15	/15
	/15	/15	/15
NUMBER OF CONTINUATION BOOKLETS USED	.....	TOTAL	TOTAL
	/45	/45	/45

**Option A – Diet and human nutrition**

**A1.** For breakfast, a student eats a 50 g bowl of cereal and drinks 500 g of milk. The diagram shows the nutritional content of the breakfast for some of the nutrients as a percentage of the RDA (recommended daily allowance). The centre of the diagram represents 0 % of the RDA for a nutrient and the outermost line represents 100 % of the RDA.



- (a) Calculate the percentage of the RDA of folic acid contained in the breakfast. [1]  
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- (b) The breakfast provides the total RDA for one of the nutrients. Identify the nutrient. [1]  
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- (c) Calculate the amount of cereal without milk needed to obtain the RDA of zinc. [1]  
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*(This question continues on the following page)*

*(Question A1 continued)*

- (d) The student is advised to increase the amount of iron and calcium in her diet. Evaluate how this could be achieved by altering the intake of cereal and milk. [2]

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- A2.** (a) State **one** example of a food that has a high lipid content. [1]

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- (b) List **two** functions of lipids in the body. [2]

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

- (c) Discuss the possible effects of high levels of saturated lipids in the diet. [3]

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- A3.** (a) State the unit used by scientists to measure the energy content of foods. [1]

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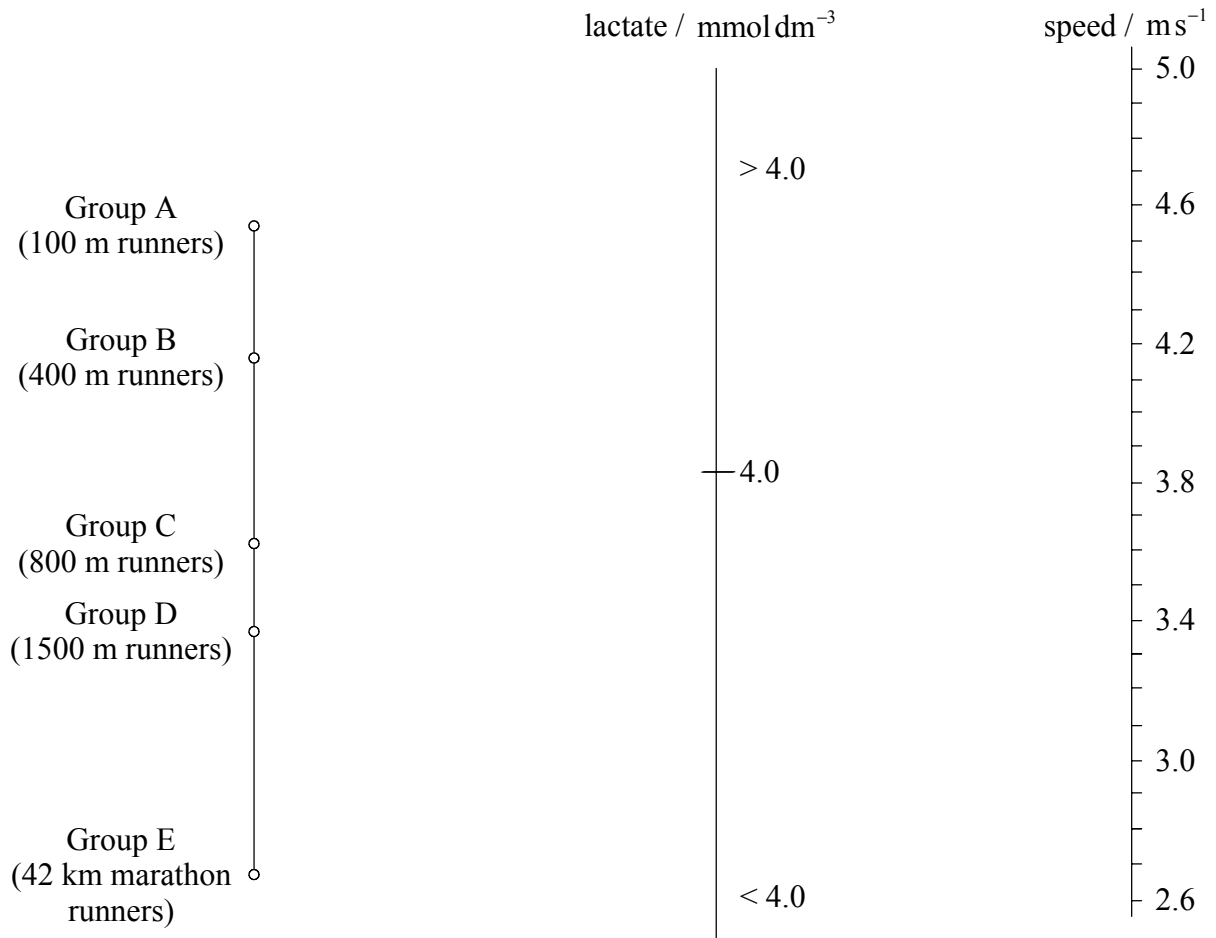
- (b) Explain the reasons for the differences between humans in energy requirements. [3]

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**Option B – Physiology of exercise**

**B1.** Members of the German women’s athletic team were grouped according to the distance they normally run in competitions. Each group was asked to run at different speeds for a set time, and the concentration of lactate in the blood was measured. If the level of lactate in the blood rises above  $4.0 \text{ mmol dm}^{-3}$  the athlete is relying on anaerobic respiration to provide the energy for running. If the lactate level is less than  $4.0 \text{ mmol dm}^{-3}$  then the athlete respire aerobically.

The nomogram below can be used to estimate the level of lactate for each group at different speeds of running.



(a) Estimate the speed at which the 400 m runners would have a lactate level of  $4.0 \text{ mmol dm}^{-3}$ . [1]

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(b) Identify which groups of runners could run at  $4.2 \text{ ms}^{-1}$  while respiring aerobically. [1]

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(c) Predict, with a reason, whether half marathon (21 km) runners would respire aerobically or anaerobically while running at  $4.2 \text{ ms}^{-1}$ . [1]

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*(This question continues on the following page)*

*(Question B1 continued)*

- (d) Compare, by giving **one** similarity and **one** difference, the respiration of the 100 m runners with the respiration of the marathon runners as the speed of running increases. [2]

Similarity: .....

Difference: .....

- (e) Explain which type of muscle fibres the 100 m runners would have in relatively high proportions. [2]

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- B2.** (a) State the subdivision of the skeleton to which the bones of the arms and legs belong. [1]

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- (b) Draw a diagram to show the structure of the human elbow joint. [3]

- B3.** (a) Explain the use of rest and ice in the treatment of muscle injuries. [2]

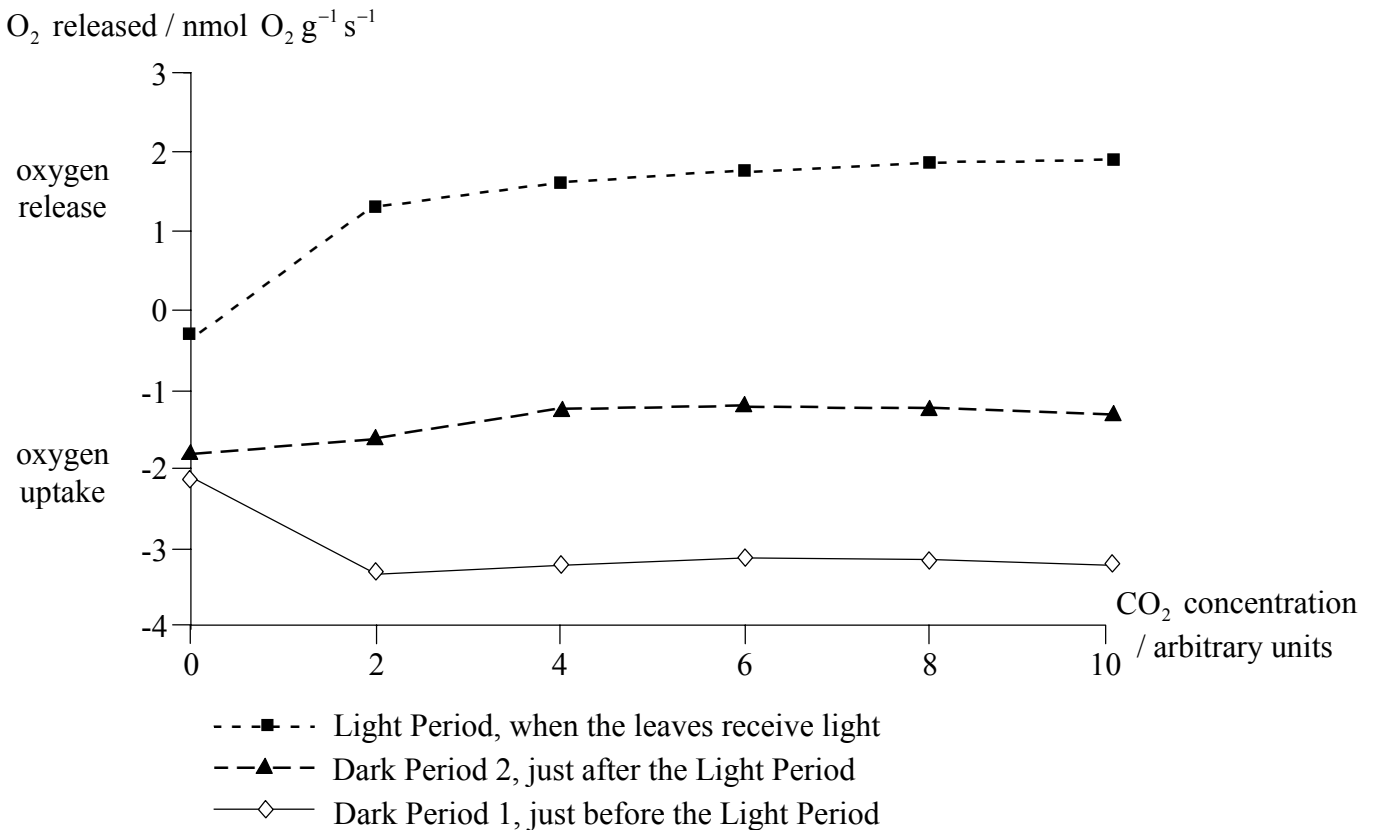
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- (b) State **two** other methods of treating muscle injuries. [2]

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

**Option C – Cells and energy**

**C1.** *Pseudopanax laetus* is a tree found in New Zealand. The graph below shows the rate of oxygen exchange (uptake or release) from the leaves of the tree at different atmospheric CO<sub>2</sub> concentrations. Measurements were made when the leaves had been in the dark for a long time (Dark Period 1), when the leaves were being exposed to light (Light Period) and when the leaves were in the dark a short time after having been exposed to light (Dark Period 2).



(a) State the period in which most oxygen is absorbed by the leaves per second. [1]

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(b) Describe the effect that increasing the carbon dioxide concentration has on oxygen exchange during the Light Period. [2]

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(This question continues on the following page)

*(Question C1 continued)*

- (c) Compare the effect of increasing the concentration of carbon dioxide in Dark Period 1 with Dark Period 2. [2]

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- (d) Explain the reason for the amount of oxygen released during the Light Period being less than zero, when no carbon dioxide is added. [2]

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- C2.** (a) Explain how the secondary structure contributes to the overall structure of proteins. [3]

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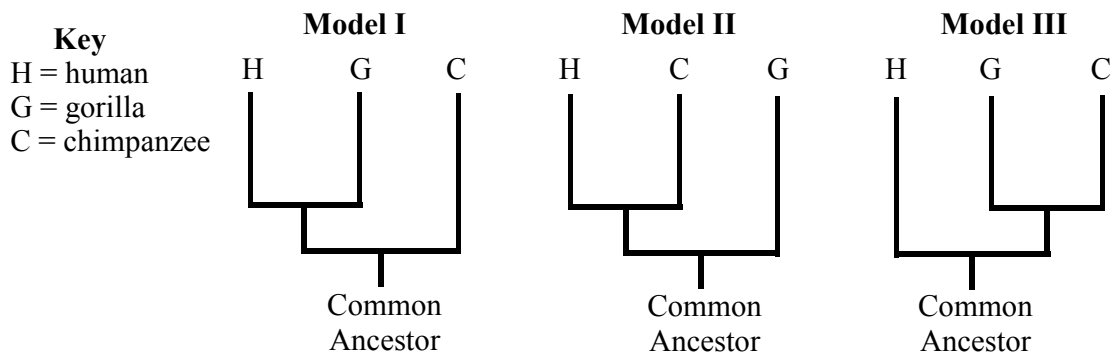
- (b) Explain the effect of enzymes on the activation energy of chemical reactions. [2]

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- C3.** Draw, in the space below, the structure of a mitochondrion as seen in electronmicrographs. [3]

**Option D – Evolution**

**D1.** Evidence suggests that humans are descended from a species of African ape that has spread to colonise new areas. The species most closely related to humans are the chimpanzee and the gorilla. Studies of biochemistry and chromosome numbers provide conflicting evidence of the evolutionary relationship between these three primates. Three models showing possible relationships have been drawn, and some of the evidence on which the diagrams were constructed has been listed.



Evidence	Human	Chimpanzee	Gorilla
Chromosome number	46	48	48
Plasma proteins	same as both gorilla and chimpanzee	same as both human and gorilla	same as both human and chimpanzee
Myoglobin	differs by one amino acid from both chimpanzee and gorilla	same as gorilla	same as chimpanzee
Haemoglobin	same as chimpanzee	same as human	differs by one amino acid from both chimpanzee and human

(a) Identify which model appears correct according to the evidence from chromosome number. [1]

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(b) Evaluate **each** of the models according to the biochemical evidence. [3]

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(Question D1 continued)

- (c) Canine teeth can be divided into two groups, large or small. The evidence from canine teeth supports Model III. Gorillas have large teeth. Deduce the type of teeth that chimpanzees and humans have. [1]

Chimpanzees: ..... Humans: .....

- (d) Humans, chimpanzees and gorillas are all classified as primates. State **two** physical features that show that they are primates. [2]

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

- D2.** (a) Outline the theory that life on Earth originated by panspermia. [2]

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- (b) State **one** other theory for the origin of life. [1]

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- D3.** (a) One type of evidence for evolution comes from studies of antibiotic resistance in bacteria. Explain briefly the evolution of antibiotic resistance in bacteria. [3]

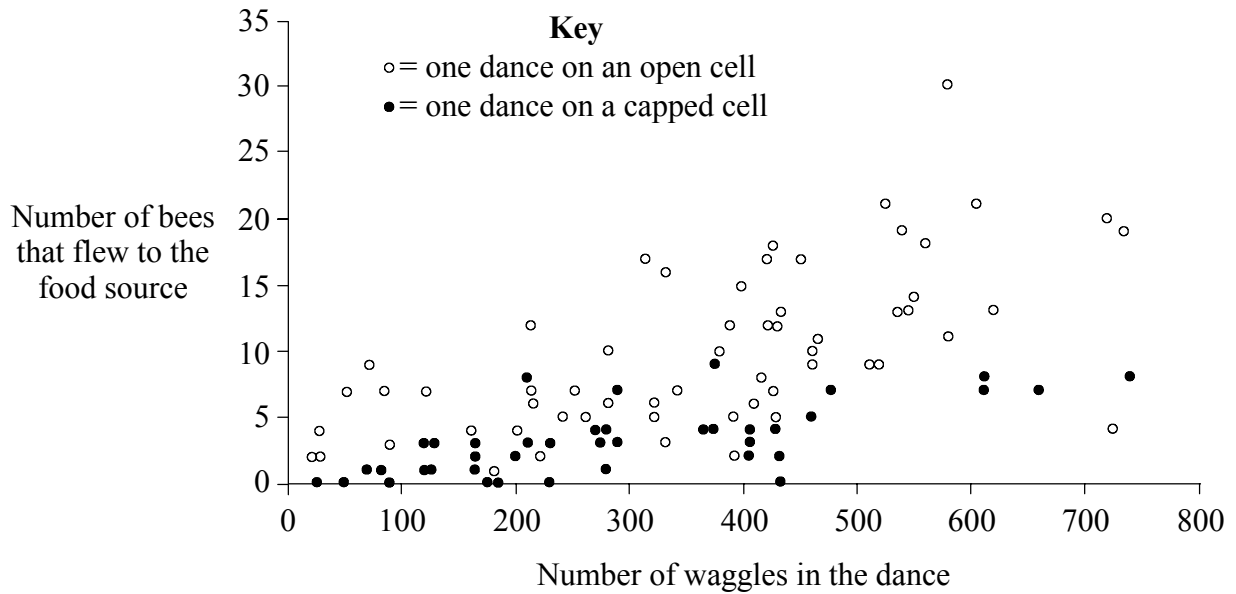
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- (b) Outline how palaeontology can provide another type of evidence for evolution. [2]

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**Option E – Neurobiology and behaviour**

**E1.** Bees are social insects that live in colonies and feed on plant nectar. When a worker bee finds nectar, it returns to the colony and performs a dance. During some dances, the bees repeatedly turn in a figure of eight. One turn in the dance is known as a waggle. This dance lets other worker bees know where the nectar is found so they can fly directly to the food source. Scientists in Germany observed that the waggle dance was sometimes performed on empty open cells of the honeycomb and sometimes on cells which had a cap on them (capped cells). They observed the behaviour of bees to see if the number of waggles and the type of cell where the dance was carried out affected the number of bees that later flew to the food source.



- (a) State the greatest number of bees that flew to a food source following one dance. [1]  
.....
- (b) State the number of times when a dance did not result in any bees flying to the food source. [1]  
.....
- (c) Identify **one** relationship, shown by the data for open cells. [1]  
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(Question E1 continued)

- (d) Compare the data for open cells with capped cells. [2]

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- (e) The inside of a colony is dark. Suggest how the bees know whether the dance is taking place on open or capped cells. [1]

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- E2.** (a) State the number of pairs of cranial nerves that are attached to the brain. [1]

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- (b) Outline the Hering-Breuer cranial reflex. [4]

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

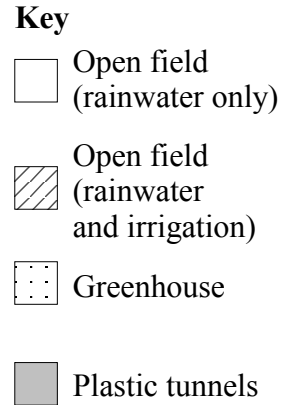
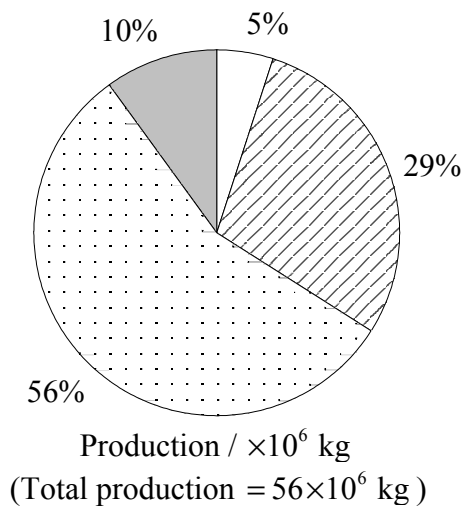
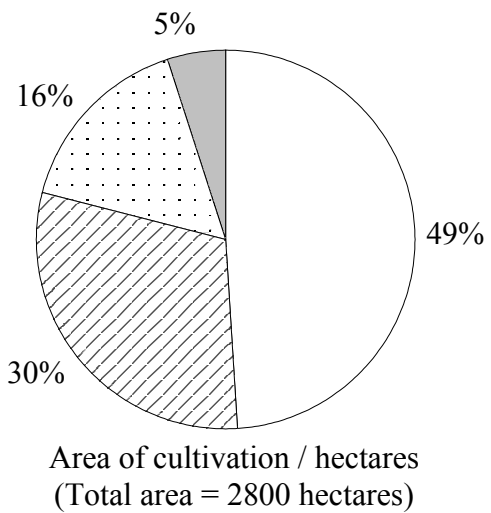
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- (b) Explain how innate behaviour patterns may develop due to natural selection. [3]

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**Option F – Applied plant and animal science**

**F1.** Vegetables crops are grown to the west of the River Jordan, using various agricultural techniques. Some of the crops are grown outside in open fields, some in plastic greenhouses and others at first under plastic tunnels which are removed once the crop is established. Some of the crops in open fields receive water only when it rains and others are irrigated. The pie charts show the area of cultivation and the production of vegetables for each cultivation method, as a percentage of the totals.



(a) Calculate:

(i) the area of open field that was irrigated for growing vegetables; [1]

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(ii) the mass of vegetables produced in plastic tunnels. [1]

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(b) Evaluate the four methods of production, using the data in the pie charts. [4]

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**F2.** (a) Compare how climatic conditions affect food availability in developed and developing countries. [2]

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(b) State **two** factors other than climatic conditions that can affect food production. [2]

1. ....
2. ....

**F3.** (a) Define *pollination*. [2]

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(b) Compare wind and insect pollinated flowers by showing **three** differences in the table below. [3]

Wind Pollinated	Insect Pollinated
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.....	.....
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**Option G – Ecology and conservation**

**G1.** The World Conservation Union consulted teams of scientists around the world to estimate the current numbers of each vertebrate species. The species were then grouped according to the danger of them becoming extinct. All known species of mammals and birds were studied. For reptiles, fish and amphibians a representative sample of species was studied to find the percentage that were threatened or endangered. Threatened species have a high probability of becoming endangered in the near future. Endangered species are in immediate danger of extinction.

Class of vertebrate	Total number of species known	Number of species studied	% of the number of species studied	
			Threatened	Endangered
<b>Mammals</b>	4400	4400	14	11
<b>Birds</b>	9615	9615	7	4
<b>Reptiles</b>	6300	1277	12	8
<b>Fish</b>	24 000	2158	21	13
<b>Amphibians</b>	4000	527	15	10

(a) Calculate the total number of species of mammals that are threatened or endangered.

[2]

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(b) The data for the fish could be considered least reliable. Suggest **two** reasons why this may be so.

[2]

1. ....  
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2. ....  
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*(This question continues on the following page)*

(Question G1 continued)

- (c) Assuming the data in the table is reliable, identify, the group that is most in need of conservation measures. [3]

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- G2. Explain the relative amounts of biomass normally found in the different trophic levels of an ecosystem. [3]

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- G3. (a) The student's *t*-test is used to analyse two sets of data. Outline the significance of a large value of *t*. [2]

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- (b) Outline **three** reasons why conservation of biodiversity in a rainforest is desirable. [3]

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