1 Professor John Lawton researches into the problem of controlling the spread of bracken. Bracken is a fern which threatens upland farms, partly because it poses a health risk to people and animals.

Professor Lawton is waiting for government permission to release the Conservular caterpillar which feeds on the bracken.

The Secretary of State has to decide whether the Conservular caterpillar can be released.

The article printed below describes some of the problems faced by the Secretary of State.

David the caterpillar to bracken's Goliath

Yorkshire farmer Maurice Cottrill has just forked out £500 to have a helicopter hover over his land and spew out gallons of chemicals aimed at destroying one of the most pervasive and dangerous weeds known to man – bracken. In a little box in a laboratory near Ascot, Berkshire, lies a tiny caterpillar which could have done the job for nothing.

Whether or not that caterpillar and thousand of its chums will ever be let loose on the massive carpet of bracken that is sweeping over Britain at the rate of 53 square kilometres a year has to be decided by the Secretary of State for the Environment.

Weed control through the release of imported insects has never been tried in Britain before. If the Secretary of State permits the experiment, the caterpillar is in for the feast of its life, because five years of painstaking research have proved that bracken is its only food. However, is that the full story? Will the beast stop there, or will it go on, wreaking unforeseen devastation. Can scientists predict what will happen when imported insects are released into the wild?

Bracken is poisonous – more than 20 000 sheep and 1 000 cattle suffer poisoning each year. Its spores are carcinogenic, posing a threat to hill walkers. Bracken costs a depressing £4m a year to control while rendering useless grazing land valued at £5m annually. "Bracken is one factor which is leading to hill farming becoming uneconomic", says the director of the Ramblers Association. "We are worried about that because, the more uneconomic hill farms become, the more prospect there is of the forestry industry taking over."

The National Farmers Union are concerned about the consequences of the caterpillar getting out of control. What if it started consuming garden ferns? What if it loved potatoes? On the other hand, the caterpillar might help to preserve important uplands where wildlife flourishes when bracken is kept at bay. However, the experiment takes the scientists into unknown territory.

World-wide, 94 species of weeds have been controlled by biological releases involving 215 types of animal in 50 countries. Professor Lawson says that approximately one-third have achieved effective control and the remainder have failed.

Upland farms are artificial ecosystems, created and maintained mainly for the rearing of sheep and cattle. These farms are being threatened by the spread of bracken. Up to now the only treatment for bracken has been to use herbicides.

Use the article to explain, as fully as you can, what advice you would give the Secretary of State.

Explain the arguments for and against that lead to your decision.

You will **not** receive marks for simply copying extracts from the article.

(Total 8 marks)

2 In tropical areas of the world, forests are being cut down at the rate of 150 hectares every minute of every day.

(a) Give **two** reasons why forests in tropical areas are being cut down at a high rate.

1. _____

_____

2. _____

_____

(2)

(b) Explain how this deforestation is affecting the composition of the atmosphere.

_____

_____

_____

_____

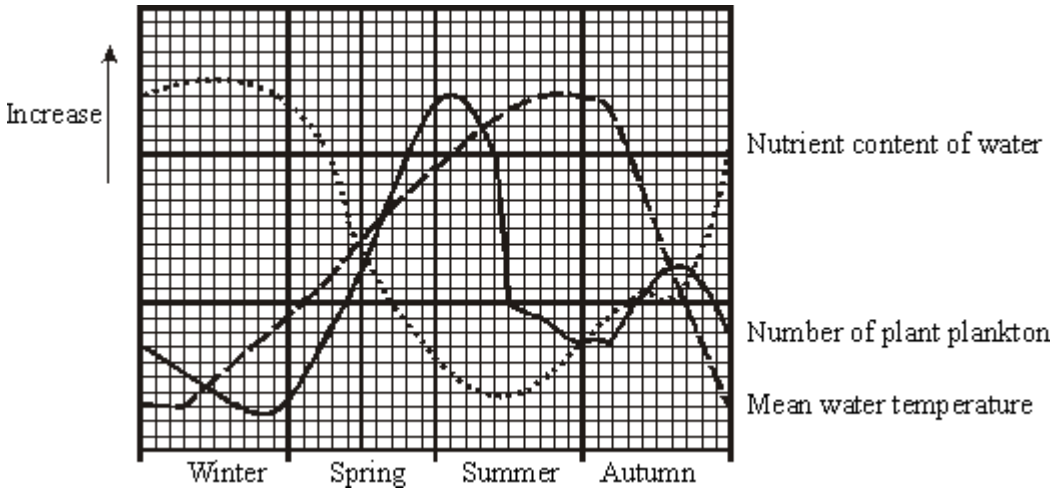
_____

_____

(5)

(Total 7 marks)

3 Plant plankton are aquatic microscopic organisms that photosynthesise. The graph shows the numbers of plant plankton in the North Sea at different times of the year.



Use the data and your knowledge of photosynthesis and growth to explain:

(a) why numbers of plant plankton were low in winter but increased rapidly during the spring,

(3)

(b) the reduction in numbers of plant plankton in the early summer.

(1)

(Total 4 marks)

4 Read the passage.

Glutton up a gum tree

Along the banks of the Cygnet River on Kangaroo Island, the branches of the dying gum trees stretch out like accusing fingers. They have no leaves. Birds search in vain for nectar-bearing flowers.

The scene, repeated mile upon mile, is an ecological nightmare. But, for once, the culprit is not human. Instead, it is one of the most appealing mammals on the planet – the koala. If the trees are to survive and provide a food source for the wildlife such as koalas that depend on them, more than 2000 koalas must die. If they are not removed the island's entire koala population will vanish.

Illegal killing has already started. Worried about soil erosion on the island, some farmers have gone for their guns. Why not catch 2000 koalas and take them to the mainland? "Almost impossible," says farmer Andrew Kelly. "Four rangers tried to catch some and in two days they got just six, and these fought, bit and scratched like fury."

Use the information from the passage and your own knowledge and understanding to give the arguments for and against killing koalas to reduce the koala population on Kangaroo Island.

_____

_____

_____

_____

_____

_____

_____

(Total 4 marks)

5 Scientists have discovered that curry spices affect sheep and cattle. Curry spices can reduce the amount of methane that grazing animals give off.

'Bad' bacteria in the animal's stomach produce methane. About 12% of the animal's foodis changed into methane.

The curry spice coriander works like an antibiotic. Adding coriander to animal food reduces methane production by about 40%.

(a) (i) Why does adding coriander to an animal's food reduce methane production?

_____

_____

(1)

(ii) Explain **one** advantage to a farmer of adding coriander to the animal's food.

_____

_____

_____

_____

(2)

(b) Farm animals give off large amounts of methane.

Explain the effects of adding large amounts of methane to the atmosphere.

_____

_____

_____

_____

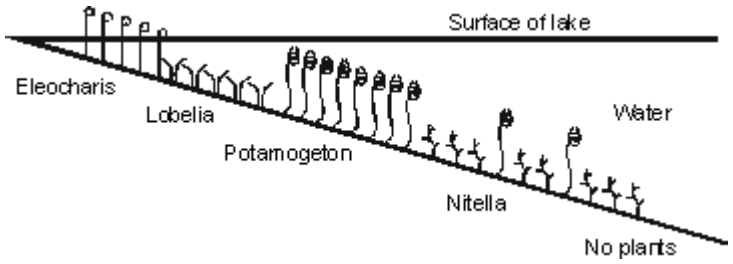
_____

_____

(3)

(Total 6 marks)

6 This is a diagram of a belt transect showing the major types of plants growing on the bottom of a lake.



(a) Suggest, and explain, **two** reasons why a much smaller population of Nitella plants is found amongst the Potamogeton plants than further down in the lake.

1. _____

_____

_____

_____

2. _____

_____

_____

_____

(4)

(b) Describe how you would use the belt transect technique to measure the abundance and distribution of plants which live on the bottom of a shallow lake.

_____

_____

_____

_____

_____

_____

(3)

(Total 7 marks)

7 Large areas of rain forest are being cleared and burnt in many parts of the world. The cleared land will often produce crops for only a few years.

(a) Explain why rain forests are being burnt to provide land for crops in many parts of the world.

(2)

(b) Explain why such cleared land will often produce crops for only a few years.

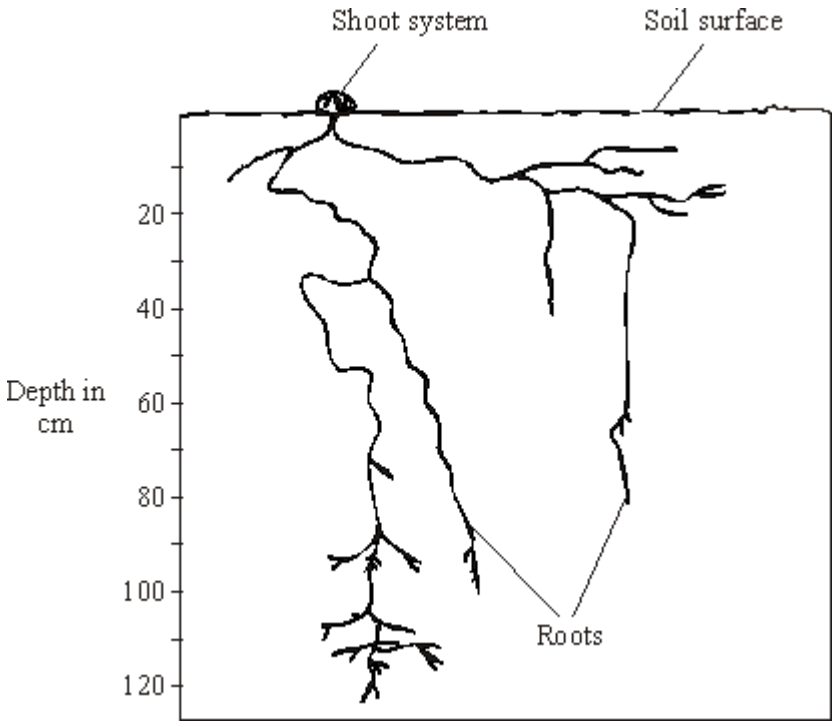
(2)

(c) Explain the effects that large-scale burning of forests may have on the Earth's atmosphere in the short and in the long term.

(4)

(Total 8 marks)

8 The diagram shows the desert plant, *Fredolia.*



Describe and explain **three** adaptations of *Fredolia,* which you can see in the diagram, that help it to survive in dry conditions.

1. _____

_____

2. _____

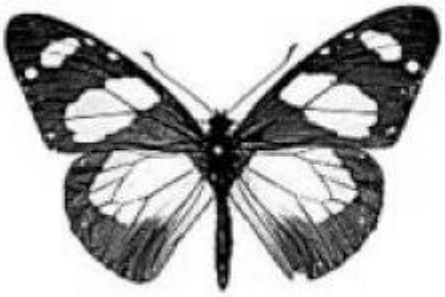
_____

3. _____

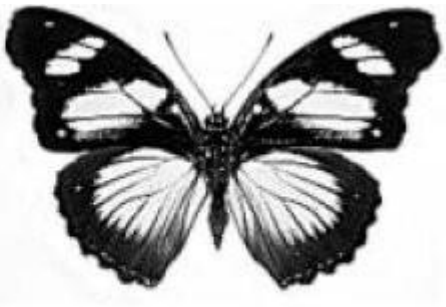
_____

(Total 3 marks)

9 The drawings show two different species of butterfly.



Amauris



Hypolimnas

- Both species can be eaten by most birds.
- *Amauris* has a foul taste which birds do not like, so birds have learned not to prey on it.
- *Hypolimnas* does **not** have a foul taste but most birds do not prey on it.

(a) Suggest why most birds do **not** prey on *Hypolimnas*.

_____

_____

_____

_____

(2)

(b) Suggest an explanation, in terms of natural selection, for the markings on the wings of *Hypolimnas*.

_____

_____

_____

_____

_____

_____

_____

_____

(3)

(Total 5 marks)

10 The photograph shows a sand gazelle.

The sand gazelle lives in the Arabian Desert where temperatures often reach 45 °C.

(a) The sand gazelle feeds only at dawn and at dusk. At other times it stays in the shade.

Suggest how this helps the animal to conserve water.

_____

_____

_____

_____

(2)

(b) During the dry season, the sand gazelle's liver and heart shrink in size. This reduces the amount of oxygen that the body needs.

Suggest how needing less oxygen helps the animal to conserve water.

_____

_____

_____

_____

(2)

(Total 4 marks)

11 (a) Explain, as fully as you can, how natural selection leads to evolution.

_____

_____

_____

_____

_____

_____

_____

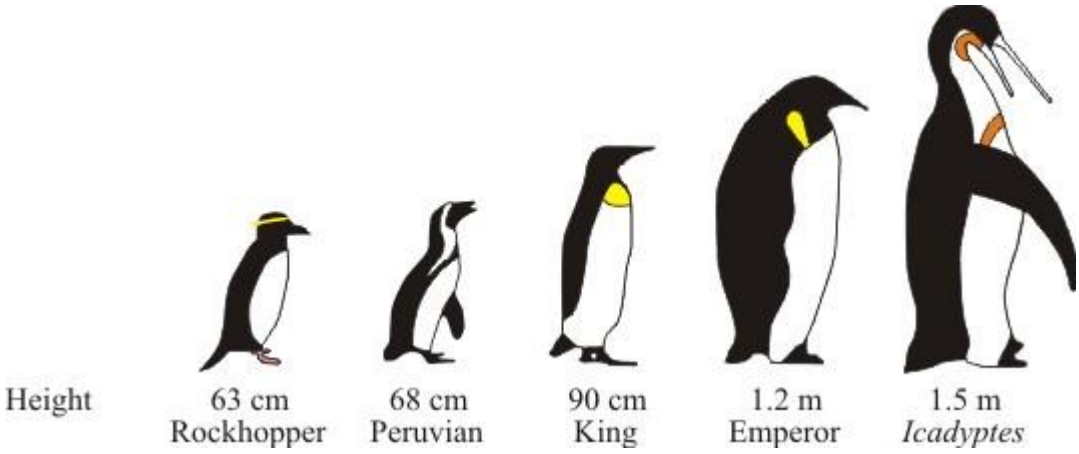
_____

(3)

(b) Most penguins live in cold climates. The modern penguin best adapted for cold conditions is the emperor penguin.

Scientists have found fossils of a 'giant' penguin which they have called *Icadyptes*.

The diagram shows how the size of modern penguins compares with *Icadyptes*.



The scientists were surprised to discover that *Icadyptes* lived in warm seas at a time when the Earth's climate was much warmer than it is now.

Explain why the scientists were surprised that *Icadyptes* lived in warm seas.

(2)

(Total 5 marks)

Mark schemes

1 Cogently argued based on biological principles, for **and** against introduction of caterpillar

maximum of 4 pros e.g.
fewer chemicals used therefore less expense
less chemical damage to other plants
consequent benefits to food chains
fewer farm animals poisoned therefore more economic
countryside more varied therefore more attractive to tourists
tourists bring economic advantages
greater variety of habitats therefore greater variety of species

any 4 for 1 mark each

4

cons e.g.
danger to livelihoods if crops destroyed by caterpillar
relatively low chance of success since only one third of schemes effective world-wide
unlikely to be natural predators therefore ecological balance affected

any 2 for 1 mark each

2

cogently argued case **gains up to 2 marks**

2

[8]

2 (a) e.g.
timber
agriculture
roads / urban development / buildings

any two for 1 mark each

2

(b) *ideas that (accept reverse arguments)*
increased carbon dioxide content since less during photosynthesis and locked-up as wood burning increases carbon dioxide content
increased activity of microbes increases carbon dioxide content
oxygen content reduced water vapour content reduced

any five for 1 mark each

5

[7]

3 (a) light and/or temperature too low in winter,
increasing light in spring leads to increase in photosynthesis
increasing temperature in spring leads to increasing metabolism/ growth/reproduction

for 1 mark each

3

(b) they run out of minerals

for 1 mark

1

[4]

4

pros e.g.:

gum trees survive therefore less soil erosion
therefore food webs not disrupted
if no culling, whole Koala population may die
easier to cull because Koalas are difficult to catch

cons e.g.:

Koala's 'right to life' / ethicalissue
better to transfer to reserves on mainland than kill
could use tranquillisers to catch without killing
could allow population to stabilise naturally

max 4 of the above; max 3 pros or cons.

[4]

5

(a) (i) kills / gets rid of / reduces methane bacteria

allow kills / gets rid of / reduces bad bacteria

ignore acts like antibiotic

1

(ii) less food converted to methane

allow can keep more cattle without further environmental damage

ignore energy

1

more growth / meat / muscle / milk produced / more profit / fatter animals

ignore references to bacteria and disease

1

(b) absorbs energy / heat radiated by Earth

allow absorbs / traps energy / heat / from Earth

*do **not** allow absorbs energy / heat from Sun*

1

some energy / heat reradiated

ignore reflected

*do **not** allow reradiates energy / heat from Sun*

1

leading to global warming / enhanced greenhouse effect

accept effects of global warming eg melting ice caps

accept methane is a greenhouse gas

ignore references to ozone

1

[6]

6 (a) e.g.:
competition for light because potamogeton plants taller
competition for nutrients taller plants may have longer roots

each for 1 mark

4

(b) descriptions of:
measuring tape or similar quadrat
method of estimating cover (inside quadrat)

each for 1 mark

3

[7]

7 (a) increased human population
increased standard of living

each for 1 mark

2

(b) nutrients absorbed by plants not replaced

each for 1 mark

2

(c) increased release of carbon dioxide into atmosphere when trees are burned
reduced rate of carbon dioxide removal from atmosphere
increased carbon dioxide absorbs more of energy radiated by Earth
global rise in temperature

each for 1 mark

4

[8]

8 any **three** from adaptation **and** effect:

ignore references to ions throughout ignore animals eating plant

few leaves / no leaves / little growth above ground / low surface area above ground so less water loss

*do **not** accept zero water loss*

deep roots

so can reach water **or** because surface soil is likely to dry out

accept 'moisture' for water

roots near surface so can obtain water when it does rain

widespread roots or many roots so can obtain water from a large area

swollen stem so can store water

[3]

9 (a) wing pattern similar to *Amauris*

1

birds assume it will have foul taste

1

(b) mutation / variation produced wing pattern similar to *Amauris*

*do **not** accept breeds with Amauris*

*do **not** accept idea of intentional adaptation*

1

these butterflies survived

1

breed / genes passed to next generation

1

[5]

10 (a) stays cool

ignore shade

1

less sweat

1

(b) any **two** from:

- breathing rate less
- less water lost via breath

less can be implied

- less water from respiration

2

[4]

11 (a) variation / mutation

1

individuals with characteristics most suited to environment survive

allow survival of the fittest

1

genes passed to next generation **or** these individuals reproduce

1

(b) any **two** from:

- similar in size to Emperor penguin **or** bigger than all penguins
- large size is adaptation to cold climate
- since less heat loss per unit of body volume **or** smaller surface area / volume ratio

2

[5]