1 Read the passage below. Use the information in the passage and your own knowledge to answer the questions that follow.

Snail Farming

The photograph shows a snail that is farmed for its meat.



Farming snails has many benefits. Economically, there are many people prepared to pay for the luxury of eating snail meat. The meat itself is high in protein. It is also low in fat, so snail meat is healthy to eat. Also, farming snails helps to conserve natural snail populations which are at risk due to being collected in large numbers in many places.

In the wild, snails grow fastest in warm temperatures and a humid atmosphere. Maintaining these conditions on a snail farm creates problems with insect pests and bacterial infections. Natural predators of the insect pests, such as spiders, are encouraged on farms, as is the constant use of fly swatters and sticky fly traps. To prevent bacterial infections, disinfectant is added to the water used to clean the cages.

Snails are herbivores but on a snail farm they are not fed with green vegetables as might be expected. Green vegetables are not assimilated very well by many organisms. The assimilation efficiency (AE) of an organism is the percentage of total food eaten that is absorbed into the blood after digestion, and not lost as faeces. Carnivores tend to have an AE of 80%, while most leaf-eating herbivores have an AE of about 50%. However, snails have symbiotic microorganisms in their gut that release the enzyme, cellulase, to digest cellulose into glucose. This boosts their AE to about 75%. Nevertheless, snails on a farm are fed with high quality food containing a mixture of amino acids, carbohydrates, vitamins and mineral ions.

The production efficiency (PE) of an animal is the proportion of assimilated food that is turned into new biomass rather than being metabolised. Birds and mammals have a very low PE of 1 to 2%, but snails have a much higher PE. This is because the metabolic use of assimilated food, particularly glucose, is much reduced in snails.

Selective breeding is used on a snail farm to produce fast-growing snails that have thin shells and lay lots of eggs. The eggs are put on damp, sterilised soil and incubated. The young snails that hatch are put in plastic trays that are easy to clean.

(a) Explain why snail meat is healthy to eat (line 4).

(2)

(b) Suggest a reason why conservationists are pleased that snail farming exists.

(1)

(c) Name the organism used in biological control on snail farms.

(1)

(d) The shell of a snail is called an exoskeleton.

Use this information to suggest **one** mineral ion in the diet of farmed snails that would help them to make their shell.

(1)

(e) (i) Suggest why many organisms cannot assimilate green vegetables very well (lines 14 and 15).

(2)

(ii) Calculate the assimilation efficiency (AE) of a snail that ate 4.0 g of food and produced 1.2 g of faeces.
Show your working.

(2)

Answer ..... %

(f) Suggest why the production efficiency (PE) of birds and mammals is much less than the PE of snails (lines 23 and 24).

(2)

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(g) What is meant by the term **selective breeding** (line 26)?

(1)

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(h) Suggest why snail eggs are put on soil that has been sterilised (line 27).

(1)

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(Total for Question = 13 marks)

2 Read the passage below. Use the information in the passage and your own knowledge to answer the questions that follow.

Bees



Photographer: Eigene Aufnahme, August 2006

Bees are insects that are important for the pollination of flowers of many plants. Bees are attracted to flowers to collect a sweet substance called nectar. After collecting nectar they return to their nest. Some of the nectar is used to make honey. Humans keep bees in small homes called hives and collect some of the honey. The bees live in a group called a colony inside the hive and they do not mate as individual pairs like most insects.

Each bee colony consists of a single fertile queen bee and her many infertile female offspring called worker bees. The colony also contains her male offspring called drones.

Under normal circumstances the fertile queen bee will fly out of the hive to mate with a number of drones from different hives. The queen takes the risk of mating in this way so that her offspring have extra genetic variation that may help to combat disease. The sperm are stored in the queen's body and released a few at a time as the eggs are laid. Some of the eggs may be fertilised by the sperm and some may not be fertilised. Fertilised eggs develop into worker bees with diploid body cells. Unfertilised eggs develop into drones.

The body cells of the fertile queen bee contain 32 chromosomes. The sperm cells produced by a single drone contain 16 chromosomes which are genetically identical to those of the other drones. If a queen bee mates with only one drone all the worker bees in the hive receive identical alleles from the drone and all the genetic variation comes from the queen. If the queen mates with two or more drones from different hives there will be greater variation in the worker bees.

It has been difficult to improve the characteristics of bees by selective breeding because bees do not mate as individual pairs. However, in the colony there are a small number of virgin queen bees that have not yet mated. These virgin queen bees can be used in selective breeding to form new colonies.

(a) What is meant by the term **pollination** (line 1)?

(1)

(b) Suggest why the bees collect nectar (lines 2 and 3).

(2)

(c) Suggest what is meant by the term **fertile** (line 7).

(1)

(d) Suggest how having 'extra genetic variation' may help the bees to combat disease (lines 12 and 13).

(2)

(e) How many chromosomes would you expect to find in an unfertilised bee egg?

(1)

(f) Explain what determines the genetic variation in worker bees.

(2)

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(g) Suggest two characteristics of a colony that would encourage a beekeeper to use the colony for selective breeding.

(2)

1 .....

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2 .....

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(Total for Question = 11 marks)